Work Plan for a Treatability Study in Support of the Intrinsic Remediation (Natural Attenuation) Option at The BX Shoppette (Site E11)



Eaker Air Force Base Blytheville, Arkansas

Prepared For

Air Force Center for Environmental Excellence Technology Transfer Division Brooks Air Force Base San Antonio, Texas

and

Air Force Base Conversion Agency/OL-J Eaker Air Force Base Blytheville, Arkansas

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EAKER AIR FORCE BASE BLYTHEVILLE, ARKANSAS

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SECTION 1

INTRODUCTION

This work plan, prepared by Parsons Engineering Science, Inc. (Parsons ES), presents the scope of work required for the collection of data necessary to conduct a treatability study (TS) for remediation of groundwater contaminated with petroleum hydrocarbons at the Base Exchange (BX) Shoppette underground storage tank site (Site E11) located at Eaker Air Force Base (AFB) (the Base), near the city of Blytheville, Arkansas. Several groundwater remedial options will be evaluated as a part of the TS report, including: active bioremediation (i.e., air sparging and bioventing); groundwater extraction, treatment, and disposal (i.e., pump and treat); and natural contaminant attenuation (intrinsic remediation) with long-term monitoring. Hydrogeologic and groundwater chemical data necessary to evaluate the various remedial options will be collected under this program; however, this work plan is oriented toward the collection of hydrogeologic data to be used as input into groundwater flow and solute transport models in support of intrinsic remediation for restoration of groundwater contaminated with benzene, toluene, ethylbenzene, and xylene (BTEX).

As used in this report, the term "intrinsic remediation" refers to a management strategy that relies on natural attenuation mechanisms to remediate contaminants dissolved in groundwater and to control receptor exposure risks associated with contaminants in the subsurface. "Natural attenuation" refers to the actual physical, chemical, and biological processes that facilitate intrinsic remediation. Mechanisms for natural attenuation of BTEX include biodegradation, advection, dispersion, dilution from recharge, sorption, and volatilization. Of these processes, biodegradation is the only mechanism working to

transform contaminants into innocuous byproducts. Intrinsic bioremediation occurs when indigenous microorganisms work to bring about a reduction in the total mass of contamination in the subsurface without the addition of nutrients. Patterns and rates of intrinsic remediation can vary markedly from site to site depending on governing physical and chemical processes.

As part of the TS, the contaminant fate and transport modeling effort has three primary objectives: 1) predict the future extent and concentration of dissolved contaminant plumes by modeling the effects of advection, dispersion, sorption, and biodegradation; 2) assess the possible exposure of potential downgradient receptors to contaminant concentrations that exceed levels intended to be protective of human health and the environment; and 3) provide technical support for selection of the intrinsic remediation option as the best remedial alternative at regulatory negotiations, as appropriate. The modeling efforts for the BX Shoppette at Eaker AFB will involve completion of several tasks, which are described in the following sections.

This work plan was developed following discussions among representatives from the Air Force Center for Environmental Excellence (AFCEE), Air Force Base Conversion Agency (AFBCA), and Parsons ES at a meeting held at the Base on November 16, 1995, the statement of work (SOW) for this project, and on a review of existing site characterization data. All field work will follow the health and safety procedures presented in the program *Health and Safety Plan for Bioplume II Modeling Initiative* (Engineering Science, Inc., 1993), and the site-specific addendum to the program Health and Safety Plan. This work plan was prepared for AFCEE and AFBCA.

1.1 SCOPE OF CURRENT WORK PLAN

The ultimate objective of the work described herein is to provide a TS for remediation of hydrocarbon groundwater contamination at the BX Shoppette. However, this project is part of a larger, broad-based initiative being conducted by AFCEE in conjunction with the US Environmental Protection Agency (USEPA) and Parsons ES to document the

biodegradation and resulting attenuation of fuel hydrocarbons and solvents dissolved in groundwater, and to model this degradation using numerical and analytical groundwater model codes. For this reason, the work described in this work plan is directed toward the collection of data in support of this initiative. Data sufficient to develop a 30-percent design of an alternate groundwater remediation system, should intrinsic remediation not prove to be a viable remedial option at this facility, also will be collected under this program. This work plan describes the site characterization activities to be performed by personnel from Parsons ES in support of the TS and the groundwater modeling effort. Field activities will be performed to determine the extent of mobile and residual light nonaqueous-phase liquid (LNAPL) at the site and to determine the extent of dissolved contamination. The data collected during the TS will be used along with data from previous investigations to complete the characterization of the site. These data will also be used in the groundwater flow and solute transport models to make predictions of the future concentrations and extent of contamination.

Site characterization activities in support of the TS will include: 1) determination of preferential contaminant migration and potential receptor exposure pathways; 2) soil sampling using cone penetrometer (CPT) direct-push technology; 3) groundwater monitoring point placement; 4) groundwater sampling; and 5) aquifer testing. The materials and methodologies to accomplish these activities are described herein. Previously reported site-specific data and data collected during the supplemental site characterization activities described in this work plan will be used as input for the groundwater flow and solute transport models. Where site-specific data are not available, conservative values for the types of aquifer materials present at the site will be obtained from widely accepted published literature and used for model input. Sensitivity analyses will be conducted for the parameters that are known to have the greatest influence on the model results, and where possible, the model will be calibrated using historical site data. Upon completion of the modeling, Parsons ES will provide technical assistance at regulatory negotiations to support the intrinsic remediation option if the results of the modeling indicate that this approach is warranted. If it is shown that intrinsic remediation

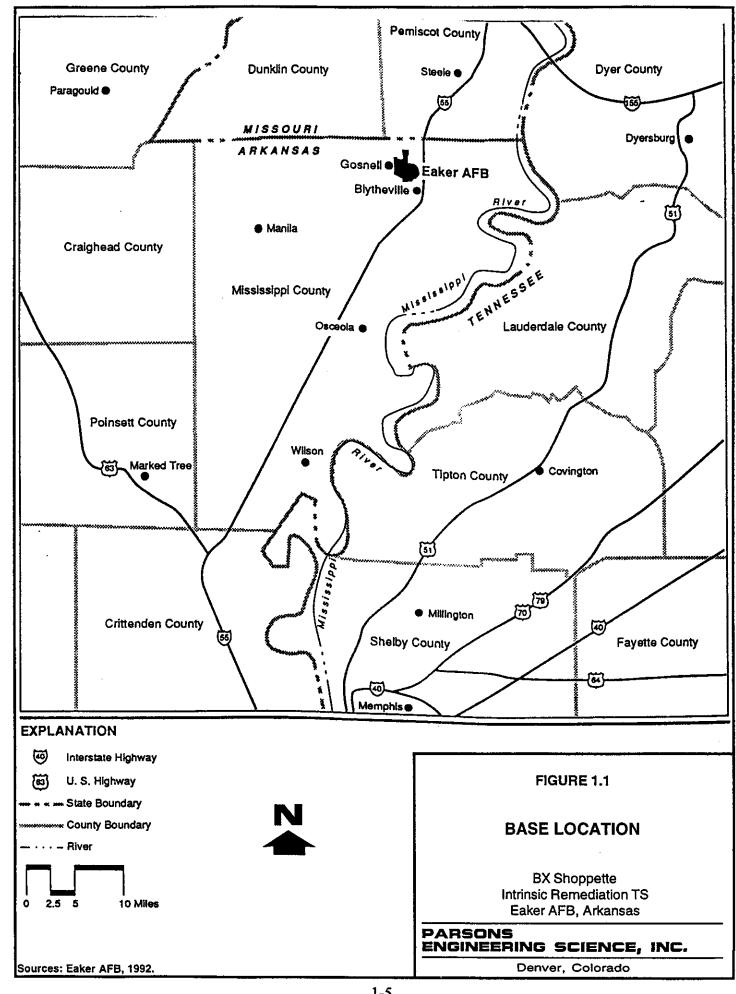
is not the most appropriate remedial option, Parsons ES will recommend the most appropriate groundwater remedial technology on the basis of available data.

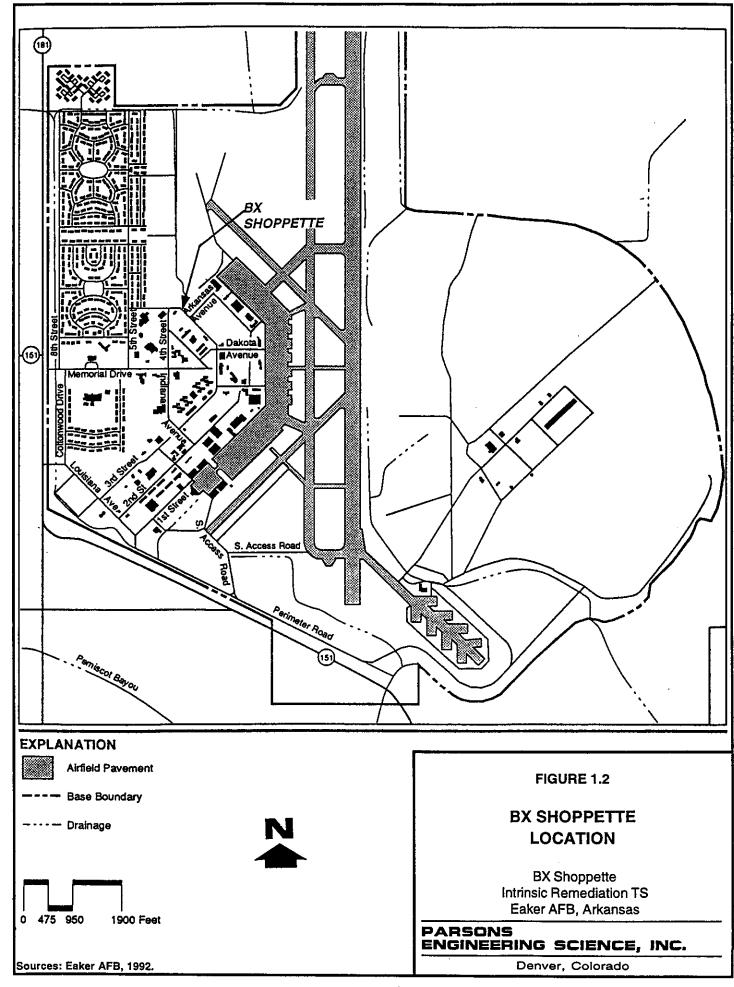
This work plan consists of six sections, including this introduction. Section 2 presents a review of available (previously reported) site-specific data, and conceptual models for the site. Section 3 describes the proposed sampling strategy and procedures to be used for the collection of additional site characterization data. Section 4 describes the remedial option evaluation procedure and TS report format. Section 5 describes the quality assurance/quality control (QA/QC) measures to be used during this project. Section 6 contains the references used in preparing this document. There are two appendices to this work plan. Appendix A contains a listing of containers, preservatives, packaging, and shipping requirements for soil and groundwater samples. Appendix B contains a summary of site data, including available well logs, and summaries of historical soil and groundwater analytical data from previous field investigations.

1.2 BACKGROUND

Eaker AFB is located in the northeastern corner of Arkansas, in Mississippi County, approximately 3 miles south of the Missouri state line and 11 miles east of the Tennessee state line. The Base occupies an area of approximately 3,300 acres 2 miles northwest of Blytheville, Arkansas and adjacent to the community of Gosnell (Figure 1.1). The Base is divided roughly in half by the main north/south runway (Figure 1.2). Aviation support, approximately 930 Base housing units, a hospital, and commercial facilities are located in the western portion of the Base. The eastern half of the Base is dedicated primarily to agricultural, recreational, and industrial activities. The predominant existing land use surrounding Eaker AFB is agricultural, with some residential parcels (Eaker AFB, 1992).

The Base was established in 1942 as the Blytheville Army Airfield and served as a training center until deactivation in 1945. From 1947 to 1955, the site was used for manufacturing, private housing, and as an airport. The Base was reactivated as Blytheville AFB in 1955 under the direction of the Tactical Air Command, and then

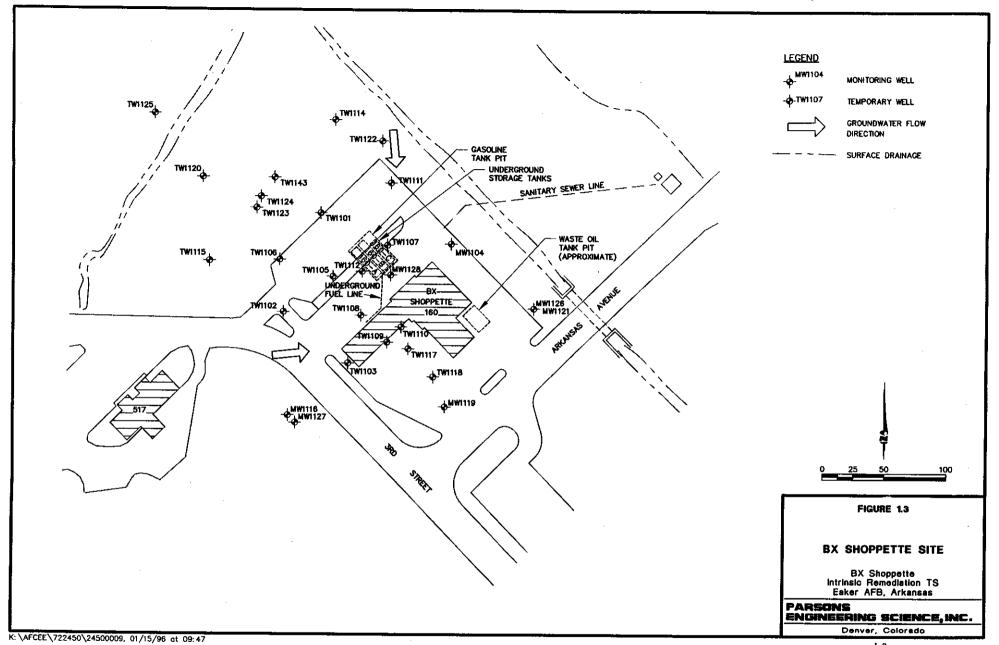




transferred to the Strategic Air Command (SAC) in 1958. The 97th Bombardment Wing assumed command of the Base until the disestablishment of SAC in 1992, when control was transferred to the Air Combat Command. In 1988, the Base was renamed Eaker AFB. Base operations in 1990 employed approximately 3,600 civilian and military personnel (Eaker AFB, 1992). In July 1991, the recommendation for base closure was approved and closure was scheduled for December, 1992.

The BX Shoppette site is located in the west-central portion of the base (Figure 1.2) and is bounded by open land to the north and west, and by base operations facilities to the east and south. Two 10,000-gallon USTs were installed at the site in 1969. The tanks (160-A and 160-B) contained regular unleaded gasoline and were steel-constructed, tar-coated, and corrosion protected by sacrificial anodes (cathodic protection). Two additional USTs (160-C and 160-D) were installed in 1971. Tank 160-C was steel-constructed, tar-coated, and cathodically protected. The tank capacity was 6,000 gallons. The tank originally contained regular leaded gasoline; however, the tank was converted to a premium unleaded gasoline tank in 1990. Tanks 160-A, -B, and -C are located within a gasoline tank pit, approximately 30 feet northwest of the BX Shoppette (Figure 1.3). Tank 160-D, a 1,000-gallon tank used to store waste oil, is located in the northeastern corner of the shoppette building (Figure 1.3). This tank is constructed of steel but is not cathodically protected (Halliburton NUS, 1994).

In 1974, a leak in the pipeline from the fuel USTs to the fuel dispensers was repaired. An unknown amount fuel was released prior to repair of the 1974 pipeline leak, and no hydrocarbon-contaminated soils were removed during the repair (Halliburton NUS, 1992). In December 1989, a tank tightness test was performed on the BX Shoppette USTs. Tank 160-A failed the tightness test and was subsequently deactivated in March 1990. In August 1990, a tank and line tightness test was performed on the remaining USTs and fuel dispensing system. This test indicated leaks in one of the 10,000-gallon USTs, the 6,000-gallon UST, and the waste oil tank. The tops of the tanks were exposed and isolated from their associated piping for retesting. All four tanks passed the retesting.



In February and June 1991 a total of 28 soil borings were installed by Professional Services, Inc. (PSI) (Halliburton NUS, 1992). These borings confirmed the presence hydrocarbons in the soil around the tank pit and identified free product in groundwater. Halliburton NUS (1992, 1994, and 1995) continued site investigation under the Installation Restoration Program (IRP) and collected additional soil samples, installed monitoring wells, and sampled site groundwater. The horizontal limits of soil BTEX contamination have been established, however the vertical extent of soil BTEX has not been defined. BTEX compounds have been detected in soil samples from 22 feet below ground surface (bgs) between the fuel tank pit and the BX Shoppette. Mobile LNAPL was up to 4 feet thick in an area southwest of the gasoline tank pit, as measured in May 1992. Groundwater is contaminated and may be preferentially migrating laterally along thin layers of silt and sand between clay layers. In February 1992, Eaker AFB personnel bailed a total of 10.75 gallons of free product from monitoring well TW1105. Other than this action, no product recovery has taken place (Halliburton NUS, 1994).

SECTION 2

DATA REVIEW AND CONCEPTUAL MODEL DEVELOPMENT

Previously reported site-specific data were reviewed and used to develop a conceptual site model (CSM) for the groundwater flow and contaminant transport conditions at the BX Shoppette. The CSM guides the selection of sampling locations and analytical data requirements needed to support the modeling efforts and to evaluate potential remediation technologies (including intrinsic remediation). Section 2.1 presents a synopsis of available site characterization data. Section 2.2 presents the preliminary conceptual groundwater flow and contaminant transport model that was developed based on these data.

2.1 DATA REVIEW

The following sections are based upon review of the following sources:

- Final Environmental Impact Statement Disposal and Reuse of Eaker Air Force Base, Arkansas (FEIS) (Eaker AFB, 1992);
- IRP Draft Site Assessment Report for the BX Shoppette Underground Storage

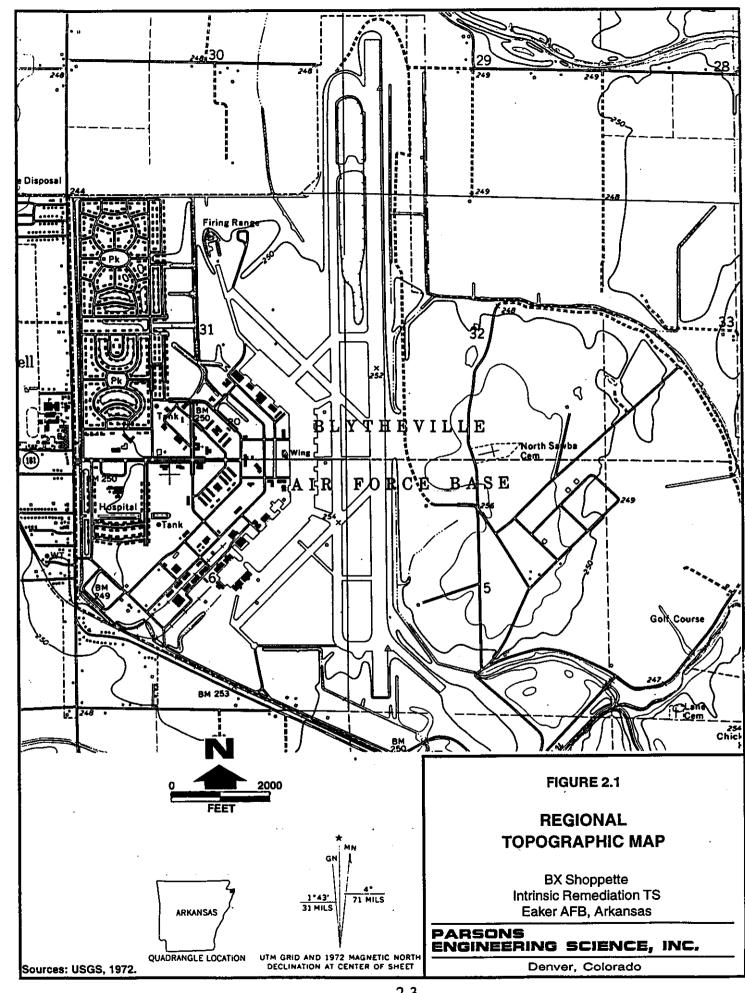
 Tank Site (Halliburton NUS, 1992),
- Unpublished site data (Halliburton NUS, 1994 and 1995); and

 Site Characterization and Analysis System (SCAPS) Report [US Army Corps of Engineers (USACE, 1995)].

2.1.1 Topography, Surface Hydrology, and Climate

Eaker AFB is located within the Mississippi Embayment of the Atlantic and Gulf Plains physiographic province (Eaker AFB, 1992), and lies within the eastern lowland portion of the Central Mississippi River Valley. The topography in the region is generally level except in areas adjacent to the Mississippi River. Ground surface elevations on the Base range from 245 feet above mean sea level (msl) at the southeastern end of the Base (in the vicinity of Pemiscot Bayou) to 265 feet msl at the northwestern end of the Base, near the firing range (Figure 2.1). At the BX Shoppette, the topography is flat and the ground surface elevation is approximately 250 feet msl.

Eaker AFB is located within the St. Francis River watershed of the Lower Mississippi River Basin. Surface water drainage is characteristic of the Mississippi River floodplain, and drainage ditches and bayous have been dredged in the flat terrain to accommodate surface water runoff. The majority of the Base lies above the level of the 100-year floodplain, and the potential for flooding is minimal. A combination of open drainage ditches and storm drains is used to capture and direct runoff from the Base (Eaker AFB, 1992). Stormwater runoff in the eastern portion of the Base drains to Pemiscot Bayou, while surface water flow on the western half of the Base drains to Ditch 25. Both of these drainage channels flow southwest to the Little River, which discharges into the St. Francis River. The St. Francis River discharges into the Mississippi River approximately 150 miles south of Eaker AFB. Surface water flow at the BX Shoppette discharges into the adjacent surface drainages which flow into Ditch Number 25, located approximately 4,000 feet north of the site.



The Eaker AFB climate is subtropical, with mild winters and hot, humid summers. July is the warmest month with an average maximum daily temperature of 90 degrees Fahrenheit (°F). The coolest month is January with an average minimum daily temperature of 28°F. The average annual precipitation is 48.3 inches, which is evenly distributed throughout the year. The average annual relative humidity is 69 percent. Flooding occurs during periods of prolonged heavy rainfall, and during the summer months climatic conditions make tornado formation possible (Eaker AFB, 1992).

2.1.2 Overview of Geology and Hydrogeology

2.1.2.1 Regional Geology and Hydrogeology

The shallow subsurface geology of northeastern Arkansas consists of Quaternary alluvium, which is thickest near the Mississippi River and thins in a westerly direction. The alluvium is composed of interbedded clays, silts, sand, and minor gravel and has an average thickness of 125 feet (Eaker AFB, 1992). The shallow, unconsolidated, Quaternary sediments on Eaker AFT are interpreted to be flood plain and channel deposits associated with the past and present positions of the Mississippi River (Halliburton NUS, 1992). The overlying soils are weathering products of the alluvial deposits and are generally nontransmissive, fine-grained, clayey soils. These soils impede infiltration and allow for rapid runoff of surface water.

Sediments in the vicinity of the Base consist of over 2,000 feet of Tertiary and Cretaceous unconsolidated deposits overlying Lower Paleozoic carbonate bedrock (Eaker AFB, 1992). The Tertiary Wilcox Formation is present approximately 900 feet below the Base. The lower part of this formation is composed of sands that produce potable water used by Eaker AFB, the city of Blytheville, and the city of Gosnell (Eaker AFB, 1992).

The aquifer is under confined conditions, and the water quality is excellent. Water treatment is required only to remove slightly elevated iron concentrations. The lower Wilcox Formation aquifer is protected from contamination by approximately 800 feet of interbedded unconsolidated sands and clays that form the Claiborne Group.

Shallow groundwater in the vicinity of the Base is present between 7 and 12 feet bgs and in the Quaternary alluvial sands. Irrigation wells and rural residences generally obtain water from these Quaternary sands (Eaker AFB, 1992). The upper part of the Quaternary deposits consists of sandy clay and clay, while the remainder of the deposits are sand and gravel. The sands and gravels comprise the major water-bearing units in the Quaternary deposits. Water from the alluvial aquifer is characterized as moderately hard to very hard hardness (as calcium bicarbonate). The water table is highest in the area northeast of the Base, indicating an area of surface recharge to the Quaternary sands and gravels (Eaker, 1992). Flood control for the Mississippi River and local flooding are responsible for some groundwater elevation fluctuation. Groundwater in the vicinity of Eaker AFB flows southwest to south.

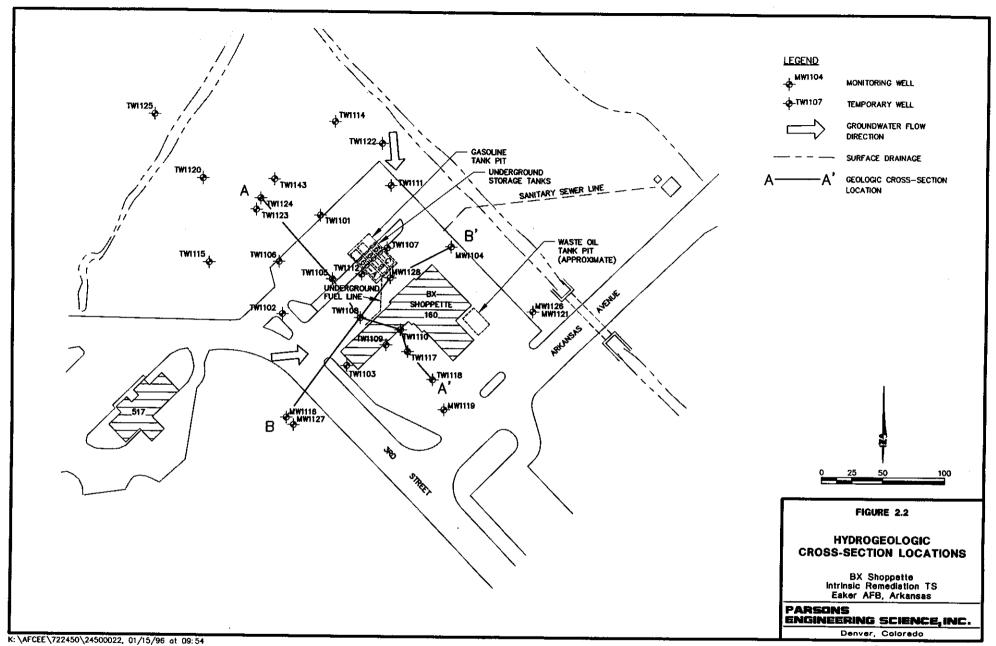
2.1.2.2 BX Shoppette Geology and Hydrology

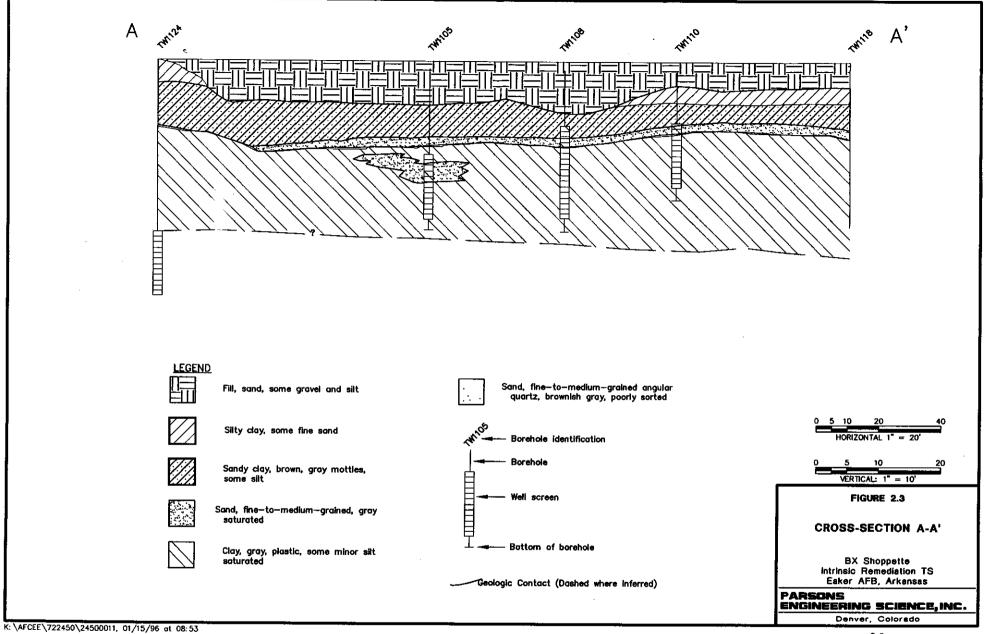
Most of the ground surface at the BX Shoppette is covered by about 6 inches of asphalt pavement overlying approximately 2 to 4 feet of sandy fill material. On the basis of information collected during the previous investigations, the shallow alluvial sediments at the site consist primarily of interbedded clays (with or without silt), sands, and sandy clays. Below the fill are several interbedded clayey, sandy, and silty layers extending to approximately 10 to 15 feet bgs. This series of units varies in texture both laterally and vertically across the site. Underlying the top 12 to 19 feet of soil is a stiff, gray and brown clay. The base of the clay layer is undefined, but this layer is suspected

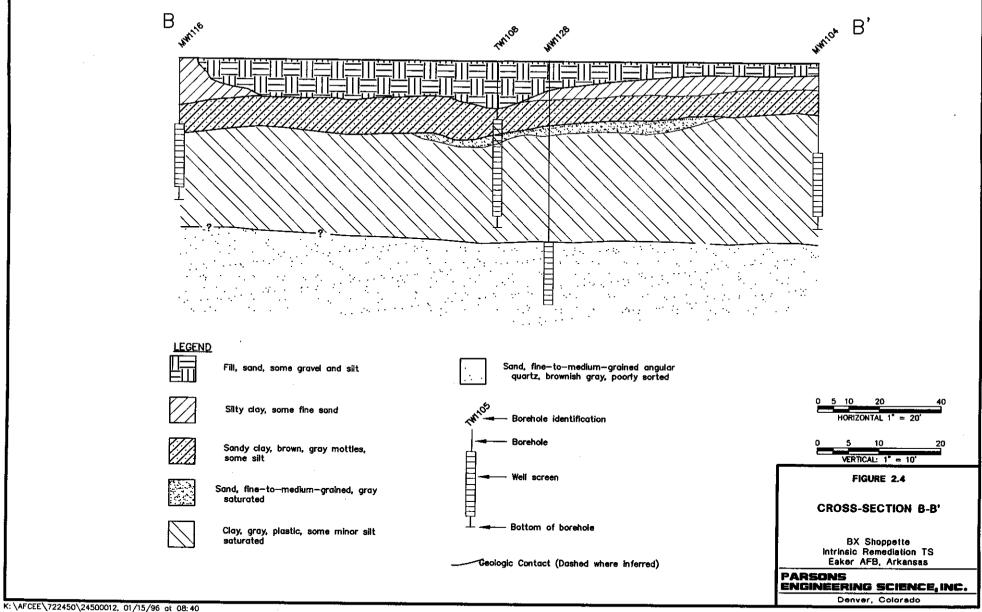
to be a minimum of 10 feet thick. A medium- to coarse-grained sand unit underlies the clay where the sand is present. The sand has not been observed in all deep boreholes and is not believed to be laterally continuous across the site. Figure 2.2 shows the location of stratigraphic cross-sections A-A' and B-B'. Figure 2.3 presents cross-section A-A', which is oriented in a northwest-southeast direction along the axis of groundwater flow. Figure 2.4 presents cross-section B-B', oriented southwest-northeast, approximately perpendicular to the direction of groundwater flow.

The cross-sections were constructed using geologic boring logs from the Halliburton NUS (1992) site investigation and CPT/laser induced fluorescence (LIF) verification data results collected by the US Army Corps of Engineers (USACE, 1995). The CPT soil data were interpreted using a soil classification graph and a fluorescence graph. The soil graph is constructed by referencing the strain gauge readings, calibration curves, and an empirical relationship. The fluorescence graph presents the relative measurement of the returned fluorescence from the LIF window on the probe. This is a relative measurement of the fuel hydrocarbon contamination. By comparing the CPT soil graph with existing adjacent soil borehole logs, the data were correlated to produce a more complete cross-section and to better define locations of suspected mobile LNAPL. Appendix B presents available geologic boring logs and CPT/LIF output logs

Borehole logs from downgradient monitoring well MW1126 at the eastern corner of the BX Shoppette near Arkansas Avenue (Figure 2.2) show that soils from the surface to 3 feet bgs are a silt and fine-grained sand. From 3 feet bgs to approximately 14 feet bgs is an orange-brown, silty clay, with the silt content decreasing with depth. Below 14 feet bgs, a dark-gray to brown clay with organic fragments and worm burrows extends to 25 feet bgs. The silt content of the clay soil increases with depth, and a fine-grained sandy







clay is present to a depth of approximately 29 feet bgs. From 29 feet bgs to a total drilled depth of 41 feet bgs a medium-grained, poorly sorted quartz sand is present.

There are currently 21 groundwater monitoring wells at the BX Shoppette. Seven former temporary monitoring wells have been abandoned at the site. All of the wells are screened in the shallow alluvial deposits. These wells were installed during several site investigations as part of the IRP. Groundwater at the site occurs in the sandy units of the Quaternary alluvium and may be perched above the finer-grained clay sediments. Available monitoring well construction details are presented in Table 2.1. Figure 2.5 shows the groundwater surface for the BX Shoppette in March 1992.

Groundwater flow in the immediate vicinity of the site appears to converge on the site from two different directions. West of the BX Shoppette the groundwater flow is to the northeast; however, the confluence of two drainage channels north of the station appears to create a recharge zone, resulting in a southerly groundwater flow from the confluence toward the site. As a result, groundwater flow directly beneath the BX Shoppette is deflected to the east by the convergent flows. The hydraulic gradient across the site ranges from 0.016 foot per foot (ft/ft) south of the fuel tank pit to 0.0017 ft/ft in the immediate tank pit and dispenser area (Halliburton NUS, 1992). The groundwater surface shown on Figure 2.5 correlates with the shape and orientation of the groundwater BTEX plume, implying that the groundwater flow direction at the site is relatively consistent. The converging groundwater flow combined with the small gradient beneath the site, gives groundwater a relatively longer residence time below the site.

In 1988, Halliburton NUS (1992) performed slug tests on shallow aquifer monitoring wells located approximately 2,500 feet northeast of the BX Shoppette. Using the methods of Bouwer and Rice (1976), hydraulic conductivity values at monitoring wells

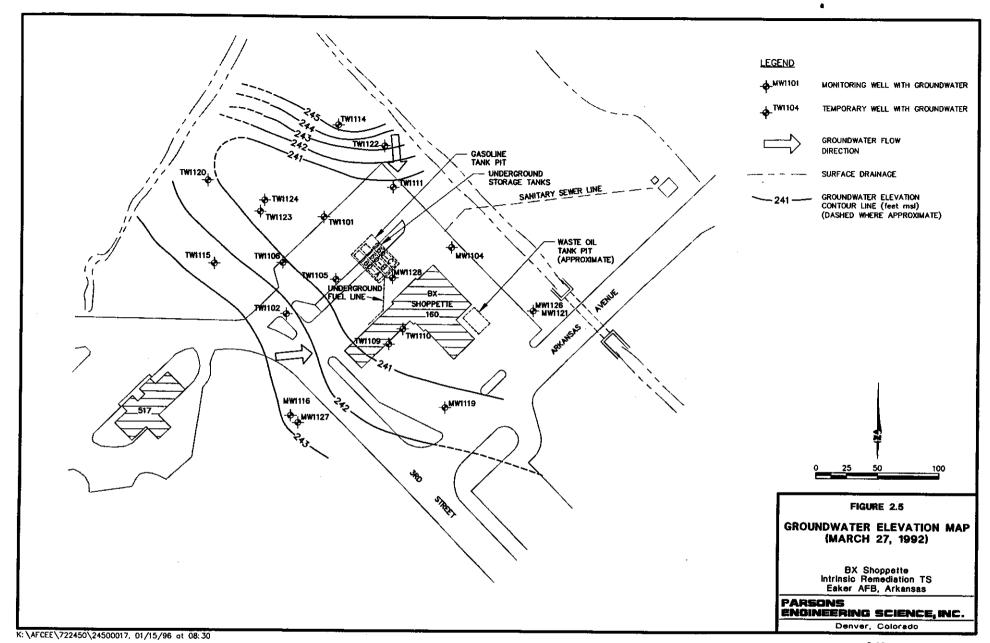
TABLE 2.1
SUMMARY OF WELL COMPLETION DATA
BX SHOPPETTE
INTRINSIC REMEDIATION TS
EAKER AFB, ARKANSAS

		Total	Completion	Screened	Ground	Top of
	Installation	Depth	Depth	Interval	Elevation	Casing
Well ID	Date	(ft bgs)	(ft bgs)	(ft bgs)	(ft msl)	(ft msl)
TW1101	12/11/91	30	27.2	15.2-25.2	NA ^{s/}	NA
TW1102	12/11/91	30	24.7	12.4-22.6	NA	249.52
TW1103 ^{b/}	12/11/91	30	27.1	15.1-25.1	NA	249.99
MW1104	12/11/91	30	26.1	14.1-24.1	NA	251.48
TW1105	12/13/91	26	25.2	13.4-23.4	NA	251.14
TW1106	12/13/91	29	25.7	13.5-23.7	NA	250.98
TW1107	12/13/91	30	27.2	15.1-25.2	NA	251.31
TW1108	12/14/91	29	25.2	8.2-23.2	NA	250.75
TW1109	12/14/91	25	20.2	8.2-18.2	NA	250.89
MW1110	12/14/91	25	20.3	8.2-18.2	NA	251,23
MW1111	12/15/91	22	20.1	8.1-18.1	NA	251.32
TW1112	12/15/91	25	25.1	8.1-25.1	NA	250.86
TW1113	12/15/91	27	25.3	8.4-23.3	NA	252.01
MW1114	12/16/91	24	18.4	6.2-16.4	NA	251.64
MW1115	12/16/91	22	18.3	6.2-16.3	NA	250.37
MW1116	12/16/91	22	20	7.9-18.0	NA	250.62
TW1117	12/17/91	12	NA	NA	NA	250.83
TW1118	12/17/91	12	NA	NA	NA	250.42
MW1119	12/17/91	22	17	5.0-15.0	NA	249.75
MW1120	1/7/92	30	29.2	17.2-27.2	NA	251.73
MW1121	4/8/95	17	16.2	4.2-14.2	250.97	253.16
MW1122	4/7/95	18	17.3	5.1-15.1	250.68	253.02
MW1123	8/11/95	20	19	7.0-17.0	251.13	253.56
MW1124	8/12/95	38	38	26.0-36.0	251.93	253.58
MW1125	10/31/95	38	38	26.0-36.0	250.58	253.48
MW1126	11/1/95	41	41	29.0-39.0	250.91	253.70
MW1127	11/3/95	37	36.5	24.5-34.5	250.76	250.56
MW1128	11/5/95	40	40	28,0-38,0	NA	251.34

^a/ NA = Data not availible.

Sources: Halliburton NUS, 1992 and 1995.

^{b'} Temporary wells TW1103, TW1107, TW1108, TW1112, TW1113, TW1117, and TW1118 have been removed.



MW502 and MW504 were calculated to be 2.1 x 10⁻⁴ centimeters per second (cm/sec) and 5.4 x 10⁻⁴ cm/sec, respectively. Using the average of these two measurements, Halliburton NUS (1992) estimated the hydraulic conductivity to be 1.06 feet per day (ft/day) (3.7 x 10⁻⁴ cm/sec) beneath the site. Using a gradient of 0.0017 ft/ft and an estimated porosity of 0.25, the groundwater velocity at the BX Shoppette is approximately 0.007 ft/day. Halliburton NUS (1992) assumed an aquifer thickness of 10 feet and calculated an estimated aquifer transmissivity of 79 gallons per day per foot (gal/day/ft) in the shallow alluvial aquifer below the BX Shoppette.

2.1.3 Summary of Analytical Data for BX Shoppette

2.1.3.1 Soil Sampling and Analytical Results

Historical soil sampling data are available for sampling events that took place in 1991 and 1995. In 1991, 56 soil samples were collected by Halliburton NUS (1994) from boreholes B-1 through B-27, and 12 soil samples were collected from boreholes for wells TW1103, TW1108, TW1109, and TW1110 (Figure 2.6). Four years later, Halliburton NUS (1995) collected 11 additional soil samples during the installation of monitoring wells MW1121 through MW1123 and soil boreholes SB1129 through SB1135. All the soil samples collected during these sampling events were analyzed for BTEX and total petroleum hydrocarbons (TPH). Some soil samples were analyzed for additional contaminants [i.e., metals and semivolatile organic compounds (SVOCs)]; however, results reported for these additional analytes are not of primary importance for completion of this TS and are not summarized in this work plan. Table 2.2 summarizes BTEX and TPH results for all soil samples collected during these sampling efforts. Locations of soil samples collected during the 1991 investigation are shown on Figure 2.6.

TABLE 2.2
SUMMARY OF SOIL ANALYTICAL DATA
BX SHOPPETTE
INTRINSIC REMEDIATION TS
EAKER AFB, ARKANSAS

		Depth	Benzene	Toluene	Ethylbenzne	Total Xylenes	Total BTEX	TPH
Borehole ID	Date	(ft bgs)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
B-1	2/91	5-10 ^{a/}	6.2	47	14	80	147.2	322
		15	2.4	8.2	4.5	17	32.1	176
B-2	2/91	5-10	2.3	24	7.7	40	74	248
		15	3.1	8.6	0.3	2.1	14.1	478
B-3	2/91	5-10	14	250	62	300	626	338
		15	3.6	16	1.8	9.8	31.2	176
B-4	2/91	5-10	ND _P	22	3.7	14	39.7	484
		15	ND	ND	ND	ND	ND	477
B-5	2/91	5-10	15	130	22	90	257	559
•		15	2.4	15	3.9	16	37.3	351
B-6	2/91	5-10	1.5	18	2.5	14	36	218
		15	1.6	6.2	1	4.6	13.4	147
B-7	2/91	5-10	3.8	44	7.3	44	99.1	212
		15	1.1	0.9	0.2	0.1	2.3	247
B-8	2/91	5-10	5	27	7	39	78	157
		15	ND	ND	ND	ND	ND	163
B-9	2/91	5-10	7.6	43	16	88	154.6	136
		15	1.6	1.4	0.2	0.5	3.7	179
B-10	2/91	5-10	11	72	20	110	213	152
		15	ND	ND	ND	ND	ND	203
B-11	2/91	5-10	3.2	15	2.8	14	35	234
		15	1.9	5.2	0.6	2.2	9.9	240
B-12	2/91	5-10	6.3	35	8.2	44	93.5	207
		15	1.6	5.2	0.5	2.4	9.7	210
B-13	6/91	5-10	5.3	24	6.8	33	69.1	<30
		15	0.7	1.1	ND	0.4	2.2	<30
		20	0.8	1.2	0.2	0.8	3	<30
B-15	6/91	5-10	5.1	4.2	9.4	73	91.7	46
		15	7.9	30	6.1	27	71	<30
		20	3.7	16	4.5	24	48.2	35
B-16	6/91	5-10	9	37	11	46	103	<30
		15	ND	ND	ND	ND	ND	<30
		20	ND	ND	ND	0.5	0.5	<30
B-17	6/91	5-10	2.3	13	4.3	26	45.6	<30
B-18	6/91	5-10	7.2	20	3.7	22	52.9	<30
		15	6.2	19	5.2	24	54.4	<30
B-19	6/91	5-10	0.5	3	5.4	19	27.9	<30
•		15	0.6	1.8	ND	0.7	3.1	<30
		20	0.7	1.9	0.3	0.8	3.7	<30

TABLE 2.2 (Concluded) SUMMARY OF SOIL ANALYTICAL DATA BX SHOPPETTE

INTRINSIC REMEDIATION TS EAKER AFB, ARKANSAS

					ERL 101 ER			
	- · · -					Total	Total	******
		Depth	Benzene	Toluene	Ethylbenzne	Xylenes	BTEX	TPH
Borehole ID	Date	(ft bgs)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
B-20	6/91	5-10	3.3	26	ND	26	55.3	<30
		15	37	280	68	400	785	<30
		20	14	130	31	160	335	<30
B-21	6/91	5-10	18	84	15	100	217	30
		15	13	54	18	83	168	64
		20	8.4	. 22	4.7	27	62.1	<30
B-22	6/91	5-10	5.3	32	7.5	44	88.8	<30
		15	. 15	65	10	51	141	<30
B-23	6/91	5-10	1	17	7.1	28	53.1	<30
		15	0.6	2	1.9	7.8	12.3	<30
B-24	6/91	5-10	1.3	17	11	29	58.3	<30
		15	0.2	2.3	1.6	7.1	11.2	<30
		20	0.2	0.6	0.2	0.9	1.9	<30
B-25	6/91	5-10	4.4	28	7.9	44	84.3	<30
		15	0.2	0.8	0.1	0.8	1.9	<30
B-27	6/91	5-10	2.4	23	9.2	36	70.6	<30
		15	1.1	10	1.6	15	27.7	<30
TW1103	12/11/95	3	< 1	<1	< 1	3	3	<20
		10	< 1	< 1	< 1	<1	<1	<20
		22	ND	< 1	< 1	< 1	<1	<20
TW1108	12/14/95	5	< 1	<1	< 1	3	3	<20
	12.10	17	<1	< 1	1	4	5	<20
		21	< l	< 1	< 1	< 1	<1	<20
TW1109	12/14/95	6	5	17	17	78	123	172
1 17 1107	12.11.55	10	<1	<1	< 1	< 1	< 1	<20
		18	<1	< 1	< 1	<1	<1	<20
TW1110	12/14/95	6-7	2	58	19	93	172	23
	12.150	8.5	1	19	<1	51	71	<20
		16.5	<1	3	< 1	3	6	<20
MW1121A	4/8/95	NA°	ND	ND	ND	ND	ND	ND
MW1121A	4/7/95	NA	< 1	< 1	ND	ND	< 1	ND
MW1122A MW1123A	8/11/95	NA NA	ND	ND	ND	ND	ND	ND ND
			ND	ND	ND	ND	ND	ND
SB1129A	4/6/95	NA NA						
SB1130A	4/6/95	NA NA	ND	ND	ND ND	ND	ND	ND
SB1131A	4/7/95	NA NA	< 1 ND	< 1	ND ND	ND	< 1	ND
SB1132A	4/9/95	NA NA	ND	ND	ND	ND	ND	ND
SB1133A	4/7/95	NA Na	ND	ND	ND	ND	ND	ND
SB1134A	4/8/95	NA NA	ND	ND	ND	ND	ND	ND
SB1135A	4/7/95	NA NA	0.9	2.7	1.1	5.4	10.1	38 570
SB1135B	4/7/95	NA	6.1	27	15	74	122.1	570

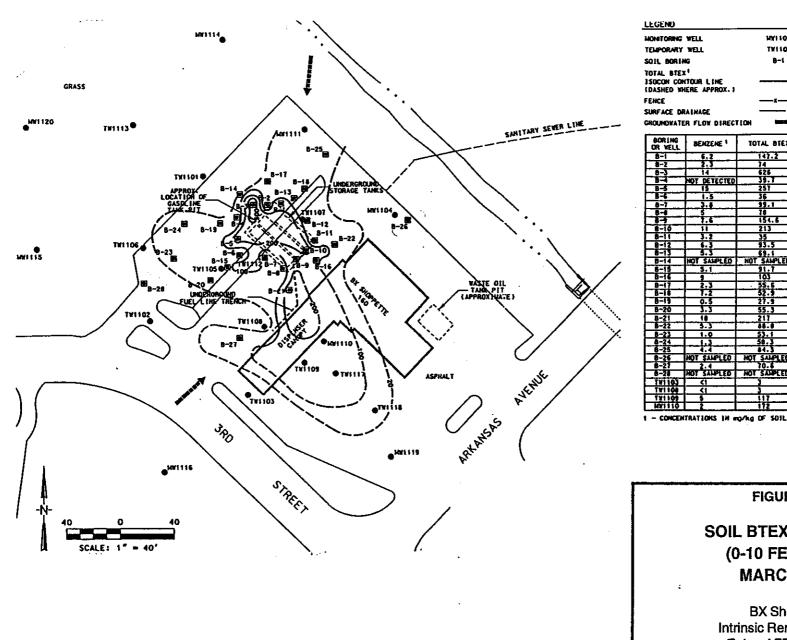
^{a/} 5-10 foot samples were composited at 5 and 10 feet.

Sources: Halliburton NUS, 1992 and 1995.

by ND = not detected.

o' NA = data not available.

Source: Halliburton NUS 1994.



LEGENU	
MONITORING WELL	NY1 104
TEMPORARY WELL	TW1101
SOIL BORING	B-1 😭
TOTAL BTEX ¹ 1SOCON CONTOUR LINE (DASHED WHERE APPROX.)	
FENCE	<u></u>
SURFACE DRAINAGE	
COCHANATED CLAY SIDECTION	

BORING OR WELL	BENZENE 1	TOTAL BIEX!
8-1	6.2	147.2
8-2	2.3	74
0-3	14	626
10-4	NOT DETECTED	39.7
B-5	15	251
B-6	1.5	36
8-7	3.4	29.1
8-0	5	78
3-7	1.6	154.6
8-10	11	213
8-11	3.2	35
8-12	6.3	93.5
6-13	5.3	69.1
B-14	NOT SAMPLED	NOT SAMPLED
6-15	5.1	91.7
B-16	9	103
B-17	2,3	55.6
B-16	7.2	52.9
B=19	0.5	27.9
B~20	3.3	55.3
B-21	10	217
B-22	5.3	88.0
B-23	1.0	53.1
8-24	1.3	50.3
6-25	4.4	\$4.3
8-56	NOT SAMPLED	HOT SAMPLED
8-27	2.4	70.6
B-28	HOT SAMPLED	NOT SAMPLED
TW1103	(1	1
TV1100	- 6	3
T¥1109	5	117
MYIIIO	2	172

FIGURE 2.6

SOIL BTEX CONTOUR (0-10 FEET BGS) **MARCH 1991**

BX Shoppette Intrinsic Remediation TS Eaker AFB, Arkansas

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

During the 1991 investigation (Halliburton NUS, 1992), saturated and unsaturated zone soil samples were collected at depths ranging from 5 to 22 feet bgs. Soil BTEX contamination was identified in saturated samples collected below the water table at 20 feet below bgs. However, the saturated samples collected below about 10 feet bgs do not correlate with surface contamination sources and are believed to result from groundwater smear of mobile LNAPL. Appendix B presents figures from Halliburton NUS (1992) that contour the soil contamination below 10 feet bgs.

Significant concentrations of BTEX and TPH in unsaturated soils appear to be limited to soils in the vicinity of the gasoline tank pit and the underground fuel line trench. Figure 2.6 is an isocontour map showing BTEX contamination in soils to a maximum depth of 10 feet bgs. The unsaturated soil BTEX contamination appears to be confined within the site boundaries. The maximum total BTEX contamination measured in unsaturated soils [626 milligrams per kilogram (mg/kg)] was detected in soil borehole B-3, adjacent to the gasoline tank pit. Unsaturated soil contamination in the region of the UST pit is concentrated mostly to the north and west of, and below, the pit. The highest unsaturated total BTEX concentration not related to the tank pit contamination was located at borehole B-21 adjacent to the fuel line trench, that lies between the tank pit and the fuel dispensers. The remainder of the soil sampling indicated lower BTEX concentrations throughout the rest of the BX Shoppette site (Figure 2.6). The fluctuation of the groundwater surface, LNAPL dispersion, and isolated small fuel spills most likely are responsible for the lower outlying soil BTEX concentrations away from the two primary source areas (i.e., the gasoline UST pit and the fuel line).

2.1.3.2 Groundwater Sampling and Analytical Results

A total of 28 monitoring wells have been installed at the BX Shoppette. All of the wells have been installed by Halliburton NUS (1992 and 1995) during several phases of investigation. Seven temporary wells (TW1103, TW1107, TW1108, TW1112, TW1113, TW1117, and TW1118) were removed by Halliburton NUS (1992) after sampling and analysis. Available well construction details are presented in Table 2.1. All of the monitoring wells at the site are screened within the shallow unconsolidated sediments. Groundwater quality data were collected from the BX Shoppette wells in 1992 and 1995 (Halliburton NUS, 1992 and 1995) as part of site assessment activities. BTEX and TPH results for both groundwater sampling events are presented in Table 2.3.

Measurable mobile LNAPL (free product) has been observed in monitoring well TW1105. Immediately after installation, well TW1105 contained 0.3 foot of LNAPL. In January 1992, 5.35 feet of product was measured at monitoring well TW1105, and in February 1992, 10.75 gallons of product was bailed from the well by Eaker AFB personnel (Halliburton NUS, 1992). In May 1992, the LNAPL was measured at approximately 4 feet. Analysis of the LNAPL indicated the product is leaded gasoline. The storage and sale of leaded gasoline at the BX Shoppette ceased in March 1990; therefore, the release that resulted in the accumulation of LNAPL in this area likely occurred before 1990. It is possible that the 1974 leak in the fuel transfer line was the source of the mobile LNAPL in this area (Halliburton NUS, 1992). The lateral extent of the mobile LNAPL plume has not been determined, but the plume is believed to be limited because it has only been observed in monitoring well TW1105. However, the observed BTEX concentration of 36,800 micrograms per liter (μg/L) in a 1995 groundwater sample from monitoring well TW1111, about 100 feet north of TW1105, is

TABLE 2.3
SUMMARY OF GROUNDWATER ANALYTICAL DATA
BX SHOPPETTE
INTRINSIC REMEDIATION TS
EAKER AFB, ARKANSAS

		_			Total	Total	
	Sample	Benzene	Ethylbenzene	Toluene	Xylene	BTEX	TPH
Well ID	Date	(μg/L)	(μg/L)	(μg/L)	(μg/L)	(μg/L)	(mg/L)
TW1101	6/1/95	610	310	440	880	2240	9
TW1102	6/1/95	ND ^{a/}	ND	ND	ND	ND	ND
MW1104	1/13/92	< 2	< 2	< 2	< 2	< 8	< 0.2
	6/2/95	130	210	170	560	1070	16
TW1105	NS ^Ы	NS	NS	NS	NS	NS	NS
TW1106	6/2/95	ND	ND	ND	ND	ND	ND
TW1109	6/5/95	2200	170	160	1100	3630	15.5
MW1110	1/13/92	4800	2000	45000 J°∕	7600	59700 J	2
	6/2/95	10000	1000	280	3200	14480	52.5
MW1111	1/13/92	5300 J	1500 J	< 2	7120 J	13920 J	2.7
	6/2/95	5000	2800	14000	15000	36800	21.2
	8/15/95	4100	2000	11000	14000	31100	67
MW1114	1/13/92	< 2	< 2	< 2	< 2	< 8	< 0.2
	6/5/95	ND	ND	ND	ND	ND	ND
MW1115	1/13/92	< 2	< 2	< 2	< 2	< 8	< 0.2
	6/5/95	ND	ND	ND	ND	ND	ND
MW1116	1/12/92	< 2	< 2	< 2	< 2	< 8	< 0.2
	6/5/95	ND	ND	ND	ND	ND	ND
MW1119	1/13/92	< 2	< 2	< 2	< 2	< 8	< 0.2
	6/5/95	ND	ND	ND	ND	ND	ND
MW1120	1/12/92	< 2	< 2	< 2	< 2	< 8	< 0.2
	6/8/95	ND	ND	ND	ND	ND	ND
MW1121	6/8/95	ND	ND	ND	ND	ND	ND
MW1122	6/8/95	ND	ND	ND	ND	ND	ND
MW1123	8/24/95	ND	ND	ND	ND	ND	ND
MW1124	8/25/95	62	5.4	4.5	10	81.9	ND

Sources: Halliburton NUS, 1992 and 1995.

a/ ND = Not detected.

 $^{^{\}mathrm{b'}}\mathrm{NS}=\mathrm{Not}$ sampled because mobile LNAPL was present.

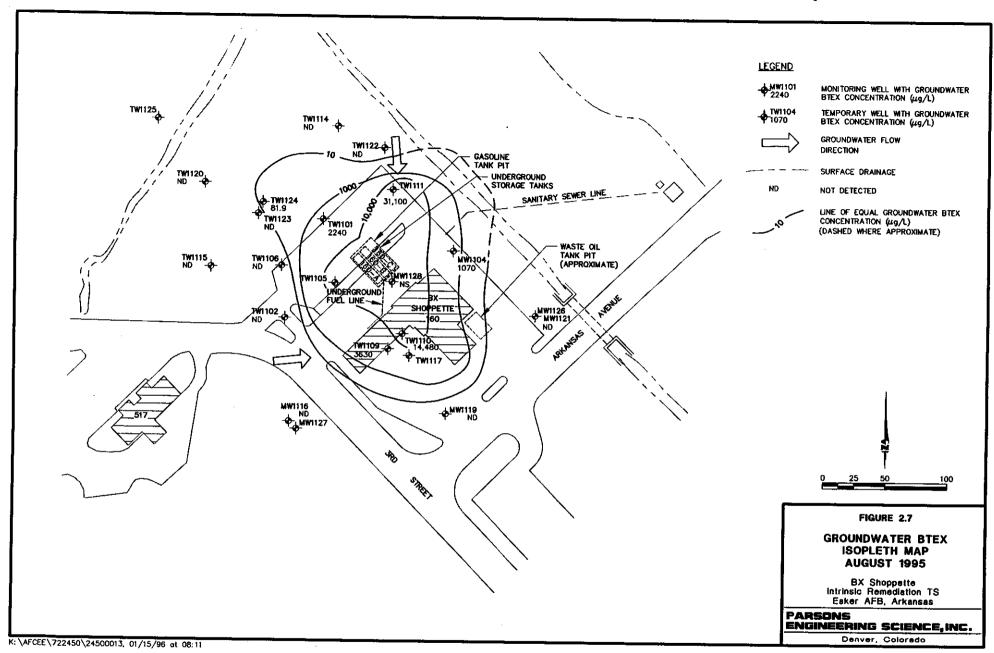
^{cl}J = Estimated value.

near equilibrium BTEX concentrations, and therefore this well may also contain free product.

Elevated concentrations of dissolved BTEX in groundwater correspond with regions of mobile LNAPL and soil contamination (Figure 2.7). Total BTEX concentrations in excess of 10,000 µg/L were detected in 1995 groundwater samples collected from TW1110 and TW1111 (Halliburton NUS, 1995). The dissolved BTEX plume shape is relatively symmetrical; and it does not appear to be traveling away from the site. The convergent groundwater flow from the west and north, coupled with the flat hydraulic gradient appears to be acting to limit plume migration away from the BX Shoppette. The shape of the BTEX plume indicates relatively minor plume expansion to the northwest and southeast. This observed plume expansion may be the result of the BTEX plume traveling within the shallow aquifer in deeper, more conductive layers. At monitoring well cluster MW1123 and MW1124, BTEX compounds were not detected in groundwater samples from the shallower well (MW1123), but 81.9 µg/L total BTEX was detected in a groundwater sample from the deeper well, (MW1124). BTEX was not detected at the shallow downgradient well MW1121; and data from the deeper adjacent well, MW1126, were not available. The downgradient extent of dissolved BTEX in deeper aquifer zones has not been completely defined.

2.1.3.3 Geochemical Indicators of BTEX Degradation

Biodegradation of dissolved fuel hydrocarbons causes measurable changes in groundwater chemistry (Wiedemeier et al., 1995). Microorganisms obtain energy for cell production and maintenance by facilitating thermodynamically advantageous reduction/oxidation reactions involving the transfer of electrons from electron donors to available electron acceptors. This results in the oxidation of the electron donor and the



reduction of the electron acceptor. Electron donors at the BX Shoppette include natural organic carbon and fuel hydrocarbon compounds. Electron acceptors are elements or compounds that occur in relatively oxidized states, and include dissolved oxygen, nitrate, ferric iron, sulfate, and carbon dioxide.

During aerobic respiration of BTEX compounds, oxygen is used as an electron acceptor during microbial mineralization of carbon, and dissolved oxygen concentration decrease. In anaerobic systems where sulfate, nitrate, and ferric iron are available electron acceptors, the concentrations of sulfate and nitrate decrease, and the ferrous iron concentrations increase. In anaerobic conditions where carbon dioxide is used as an electron acceptor, it is reduced by methanogenic bacteria, and methane is produced. Groundwater geochemical data collected at 16 wells at the BX Shoppette by Halliburton NUS (1995) are summarized in Table 2.4. The data indicate that anaerobic biodegradation of BTEX through sulfate reduction may be occurring at the site. Aerobic biodegradation may be occurring, but data indicating this are not available.

Groundwater alkalinity is a measure of the ability of groundwater to buffer changes in pH caused by the generation of biologically generated acids. Increased alkalinity in the areas of groundwater BTEX contamination can occur in response to increased carbon dioxide concentrations, which are a product of BTEX biodegradation (Morell and Hering, 1993). Figure 2.8 presents an isopleth map of groundwater alkalinity in August 1995.

Sulfate also appears depleted in the areas corresponding to the BTEX plume (Figure 2.7) at the site, which suggests anaerobic BTEX biodegradation through sulfate reduction. Figure 2.9 is an isopleth map of August 1995 groundwater sulfate concentrations. In this anaerobic process, the BTEX compounds combine with sulfate and hydrogen to produce carbon dioxide, water, and sulfur. Comparison of Figures 2.8 and 2.9 with the

TABLE 2.4
SUMMARY OF GROUNDWATER GEOCHEMICAL DATA
BX SHOPPETTE
INTRINSIC REMEDIATION TS
EAKER AFB, ARKANSAS

Well ID	Nitrate (mg/L)	Alkalinity (mg/L)	Sulfate (mg/L)	Chloride (mg/L)
TW1101	ND ^{a/}	280	13	5
TW1102	ND	270	382	5
MW1104	ND	260	38	7
TW1106	0.013	430	7	4
TW1109	0.1	330	22	36
MW1110	0.12	350	3	200
MW1111	0.03	220	ND	ND
MW1114	ND	83	102	24
MW1115	0.16	81	57	9
MW1116	0.02	120	52	3
MW1119	0.01	630	86	9
MW1120	ND	240	2.5	ND
MW1121	0.13	62	15	ND
MW1122	ND	110	46	ND
MW1123	ND ·	140	14	ND
MW1124	ND	170	28	1

 $[\]overline{a'}$ ND = Not detected.

Source: Halliburton NUS, 1995.

Denver, Colorado

ENCINEERING SCIENCE, INC. PARSONS

BX Shoppette Intrinsic Remediation TS Eaker AFB, Arkansas

AUGUST 1995 ISOPLETH MAP GROUNDWATER ALKALINITY FIGURE 2.8

LINE OF EQUAL GROUNDWATER ALKALINITY (mg/L) (Dashed where approximate)

ALKALINITY (mg/L)
TEMPORARY WELL WITH GROUNDWATER

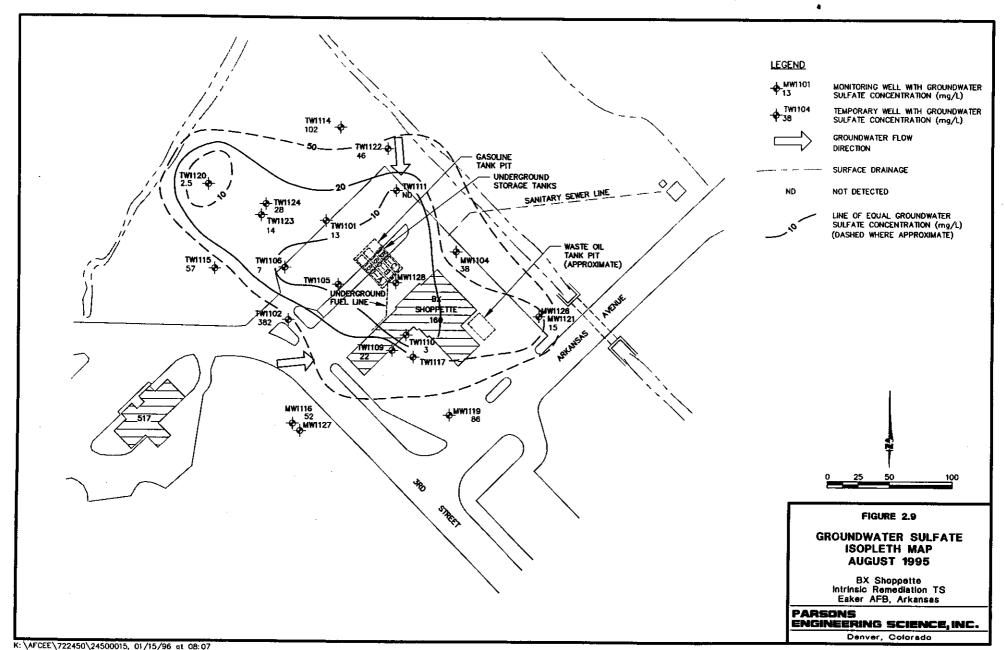
MONITORING WELL WITH GROUNDWATER ALKALINITY (mg/L)

SURFACE DRAINAGE

DIRECTION CROUNDWATER FLOW

4-260

1011WN 4 **TECEND**



groundwater BTEX plume (Figure 2.7) shows graphically that the areas of relatively high alkalinity and reduced sulfate correspond with the BTEX plume. This is a preliminary indication that biodegradation of BTEX compounds is occurring at the site. Additional analysis of these and other attenuation processes will be provided in the TS report.

2.2 DEVELOPMENT OF CONCEPTUAL SITE MODEL

A CSM is a three-dimensional representation of a site's hydrogeologic system based on available geological, hydrological, climatological, and geochemical data. A CSM is developed to provide an understanding of the mechanisms controlling contaminant fate and transport and to identify additional data requirements. The model describes known and suspected sources of contamination, types of contamination, affected media, and contaminant migration pathways. The model also provides a foundation for formulating decisions regarding additional data collection activities and potential remedial actions. The CSM for the BX Shoppette will be used to aid in selecting additional data collection points and to identify appropriate data needs for quantifying and simulating groundwater flow characteristics and evidence of hydrocarbon degradation using groundwater flow and solute transport models.

Successful conceptual model development involves:

- Defining the problem to be solved;
- Integrating available data, including
 - Local geologic and topographic data,
 - Hydraulic data,
 - Site stratigraphic data, and

- Contaminant concentration and distribution data;
- Evaluating contaminant fate and transport characteristics;
- Identifying contaminant migration pathways;
- Identifying potential receptors and receptor exposure points; and
- Determining additional data requirements.

2.2.1 Predicting Intrinsic Remediation with Fate and Transport Models

The positive effect of natural attenuation processes (e.g., advection, dispersion, sorption, and biodegradation) on reducing the actual mass of fuel-related contamination dissolved in groundwater has been termed intrinsic remediation. Advantages of intrinsic remediation include: (1) contaminants are transformed to innocuous byproducts (e.g., carbon dioxide and water), not just transferred to another phase or location within the environment; (2) current pump-and-treat technologies are energy-intensive and generally not as effective in reducing residual contamination; (3) the process is nonintrusive and allows continuing use of infrastructure during remediation; (4) current engineered remedial technologies may pose a greater risk to potential receptors than intrinsic remediation because contaminants may be transferred into the atmosphere during remediation activities; and (5) intrinsic remediation is far less costly than conventional, engineered remedial technologies.

An accurate estimate of the potential for natural biodegradation of BTEX compounds in groundwater is important to consider when determining whether fuel hydrocarbon contamination presents a substantial threat to human health and the environment (through modeling), and when deciding what type of remedial alternative will be most cost effective in eliminating or abating such threats. Over the past two decades, numerous

laboratory and field studies have demonstrated that subsurface microorganisms can degrade a variety of hydrocarbons (Lee, 1988). This process occurs naturally when sufficient oxygen (or other electron acceptors) and nutrients are available in the groundwater. Hence, biodegradation is considered the most important natural attenuation process operating to remove BTEX contamination. The rate of natural biodegradation is generally limited by the lack of oxygen (or other electron acceptors) rather than by the lack of nutrients such as nitrogen or phosphorus. The supply of oxygen to unsaturated soil is constantly renewed by the vertical diffusion from the atmosphere. The supply of oxygen to a shallow, fuel-contaminated aquifer is constantly renewed by the influx of oxygenated, upgradient flow and precipitation recharge, and by the vertical diffusion of oxygen from the unsaturated soil zone into the groundwater (Borden and Bedient, 1986). The rate of natural biodegradation in unsaturated soil and shallow aquifers is largely dependent upon the rates at which oxygen and other electron acceptors enter the contaminated media.

By combining site-specific geochemical and chemical evidence, the potential for intrinsic remediation can be quantified through fate and transport modeling. Several analytical and numerical models are available for modeling the fate and transport of fuel hydrocarbons under the influence of advection, dispersion, sorption, and natural aerobic and anaerobic biodegradation. Analytical models may be used in conjunction with numerical models, such as Bioplume II, as appropriate. The Bioplume II numerical model is based upon the US Geological Survey (USGS) two-dimensional (2-D) solute transport model (Konikow and Bredehoeft, 1978), which has been modified to include a biodegradation component that is activated by a superimposed plume of dissolved oxygen. Bioplume II solves the USGS 2-D solute equation twice, once for hydrocarbon concentrations in the groundwater and once for a dissolved oxygen plume. The two

plumes are then combined using superimposition at every particle move to simulate biological reactions between fuel products and oxygen. As appropriate, biodegradation of contaminants by anaerobic processes is simulated using a first-order decay rate. The Bioplume II model will be used to predict the fate and transport of contaminants at the BX Shoppette site.

2.2.2 Initial Conceptual Site Model

The BX Shoppette hydrogeologic data were previously integrated to produce two hydrogeologic cross-sections of the site. Cross sections A - A' and B - B' (Figures 2.3 and 2.4) show the interbedded hydrostratigraphic units present at the site as determined from previous cross-sections and USACE (1995) CPT results. Figure 2.5 is a groundwater surface map prepared using March 1992 groundwater elevation data (Halliburton NUS, 1992)

The water table is present at approximately 7 to 12 feet bgs, in the silty sand and sandy clay deposits in the beneath the site. Groundwater flow converges in the site vicinity from the west and north, with gradients ranging from 0.016 ft/ft to 0.0017 ft/ft. On the basis of the available data, Parsons ES will model the site as an unconfined, fine-grained sand aquifer interbedded with clay sediments. The aquifer may become confined with depth due to overlying clay units, and the CSM will be modified as necessary as additional site hydrogeologic data become available. Vertical migration of site contaminants in groundwater will be further investigated in the source area near monitoring well TW1105 to evaluate the spread of dissolved BTEX in different aquifer subunits.

Mobile LNAPL is believed to be present at the BX Shoppette, and it may be necessary to use the fuel/water partitioning models of Bruce et al. (1991) or Cline et al. (1991) to provide a conservative source term to model the partitioning of BTEX from the mobile LNAPL into the groundwater. In order to use one of these models, samples of free product will be collected and analyzed for mass fraction of BTEX. Parsons ES also will collect additional groundwater samples from immediately below the LNAPL layer. Mobile LNAPL has been observed in well TW1105; the lateral extent of free product has not been determined. Figure 2.7 shows the extent of BTEX groundwater contamination at the site. Information from this map and historical soil contamination data for the site (Figure 2.6) will be used to select the locations of new monitoring wells to fully define the extents of the mobile LNAPL and dissolved BTEX plumes at the BX Shoppette.

Because of it solubility and relative toxicity, benzene is the primary chemical of interest in groundwater at the BX Shoppette. However, the synergistic effects of all of the BTEX compounds on attenuation rates make site data on all of the BTEX compounds important. Therefore, the BTEX compounds will be the primary focus of this intrinsic remediation TS. The Bioplume II model will be used to simulate the degradation of these chemicals at the BX Shoppette and to predict the concentrations and extent of the contaminant plumes in the groundwater over time.

Dissolved BTEX compounds at the site are expected to continue to leach from contaminated soils containing fuel residuals, to dissolve from mobile LNAPL into the groundwater, and to migrate downgradient as a dissolved contaminant plume. In addition to the effects of mass transport mechanisms (volatilization, dispersion, diffusion, and adsorption), these dissolved contaminants will likely be removed from the groundwater system by destructive attenuation mechanisms, such as biodegradation. The effects of

these fate and transport processes on the dissolved BTEX plume will be investigated using the quantitative groundwater analytical data and the solute transport models. Data collection and analysis requirements are discussed in Section 3 of this work plan.

2.2.3 Potential Pathways and Receptors

Potential preferential contaminant migration pathways such as groundwater discharge points and subsurface utility corridors (artificial conduits) will be identified during the field work phase of this project. The primary potential migration path for contaminants at the BX Shoppette is from the residual LNAPL in contaminated soils and mobile LNAPL at the site into the groundwater, and from the groundwater to potential downgradient receptors via ingestion or incidental contact.

Shallow groundwater beneath the site flows toward the east. There are no known operating potable or nonpotable water wells (other than monitoring wells) located within 1 mile downgradient or crossgradient from the site. Surface drainage by overland flow from the site discharges into the adjacent surface drainages and flows into Ditch 25, north of the site. Shallow soil contamination at the site is located at the gasoline tank pit and fuel trench, and is not expected to impact surface water quality due to the asphalt cover.

The potential for exposure to contaminated groundwater originating from the site through ingestion is low because Base access is restricted and Base drinking water does not come from wells located downgradient from the site and within the surfical aquifer. Pavement at the site prevents surface water/soil contact. However, fuel vapors could migrate into the BX Shoppette building. There are four deep-aquifer potable- water wells located approximately 2.3 miles southeast of the Base that are used by the city of Blytheville. Site contaminants are not expected to migrate to any of these drinking water

wells. However, determining the potential impacts from shallow groundwater discharge into the adjacent drainage ditch will be of primary importance for assessing the feasibility of intrinsic remediation at the BX Shoppette and will be considered in greater detail once additional site data essential for the evaluation of intrinsic remediation have been collected.

SECTION 3

COLLECTION OF ADDITIONAL DATA

To complete the TS and to evaluate whether natural attenuation of fuel-related contaminants is occurring, additional site-specific hydrogeologic data will be collected. The physical and chemical hydrogeologic parameters listed below will be determined during the field work phase of the TS.

Physical hydrogeologic characteristics include:

- Depth from measurement datum to the groundwater surface in existing monitoring wells;
- Locations of potential groundwater recharge and discharge areas;
- Locations of downgradient wells and their uses;
- Hydraulic conductivity through slug tests, as required;
- Estimation of dispersivity, where possible;
- Stratigraphic analysis of subsurface media;
- Groundwater temperature; and
- Determination of extent and thickness of mobile- and residual-LNAPL.

Chemical hydrogeologic characteristics include:

• Dissolved oxygen (DO) concentrations;

TABLE 3.1

ANALYTICAL PROTOCOL FOR GROUND WATER AND SOIL SAMPLES

BX SHOPPETTE

INTRINSIC REMEDIATION TS EAKER AFB, ARKANSAS

MATRIX Analyte	метнор	FIELD (F) OR ANALYTICAL LABORATORY (L)	
WATER			
Total Iron	Colorimetric, Hach Method 8008 (or similar)	F	
Ferrous Iron (Fe+2)	Colorimetric, Hach Method 8146 (or similar)	F	
Ferric Iron (Fe+3)	Difference between total and ferrous iron	F	
Manganese	Colorimetric, Hach Method 8034 (or similar)	F	
Sulfide	Colorimetric, Hach Method 8131 (or similar)	F	
Sulfate	Colorimetric, Hach Method 8051 (or similar)	F	
Nitrate	Titrimetric, Hach Method 8039 (or similar)	F	
Nitrite	Titrimetric, Hach Method 8507 (or similar)	F	
Redox Potential	A2580B, direct-reading meter	F	
Oxygen	Direct-reading meter	F	
рH	E150.1/SW9040, direct-reading meter	F	
Conductivity	E120.1/SW9050, direct-reading meter	F	
Temperature	E170.1	F	
Alkalinity (Carbonate [CO3-2] and Bicarbonate [HCO3-1])	Titrimetric, Hach Method 8221 (or similar)	F	
Carbon Dioxide	CHEMetrics Method 4500	F	
Nitrate	E300 or SW9056	L	
Nitrite	E300 or SW9056	L	
Chloride	E300 or SW9056	L	
Sulfate	E300 or SW9056	L	
Alkalinity	E150.1	L	
Methane	RSKSOP 175 ^{s/}	L	
Total Organic Carbon	A5310C	L	
Aromatic Hydrocarbons (Including Trimethylbenzene and Tetramethylbenzene)	SW8020	L	
Total Hydrocarbons	SW8015, modified for gasoline-range organics	L	
FREE PRODUCT			
Free Product	GS/MS, Direct Injection	L	
SOIL			
Total Organic Carbon	SW9060	L	
Moisture	ASTM D-2216	L	
Aromatic Hydrocarbons	SW8020	L	
Total Hydrocarbons	SW8015, modified for gasoline-range organics	L	

^{a/}RSKSOP = Robert S. Kerr Laboratory standard operating procedure.

- Specific conductance;
- pH;
- Chemical analysis of mobile LNAPL to determine mass fraction of BTEX; and
- Additional chemical analysis of groundwater and soil for the parameters listed in Table 3.1.

Field work described in this work plan in support of the TS will be completed in March 1996. The objective of field work will be to define the extent of residual and mobile LNAPL hydrocarbon contamination using CPT in conjunction with LIF testing and soil, groundwater, and mobile LNAPL sampling. Areas of residual and free-phase hydrocarbon contamination were sampled during field operations conducted in 1991, 1992, and 1995; however, additional LIF testing will be required during the upcoming field operations to better define the extent of residual and mobile LNAPL.

The following sections describe the procedures that will be followed when performing field investigations and collecting site-specific data. The CPT/LIF system is described in Section 3.1. Procedures for soil sample collection to verify CPT/LIF data are described in Section 3.1.2. Procedures for the installation of new monitoring points are described in Section 3.2. Procedures for sampling existing groundwater monitoring wells and newly installed groundwater monitoring points are described in Section 3.3, and procedures for the measurement of aquifer parameters (e.g., hydraulic conductivity) are described in Section 3.4.

3.1 CONE PENETROMETRY

Subsurface conditions at the site will be characterized using CPT coupled with LIF. Cone penetrometry is an expeditious and effective means of analyzing the stratigraphy of a site by measuring resistance against the conical probe of the penetrometer as it is pushed into the subsurface. Stratigraphy is determined from a correlation of the point stress at the probe tip and frictional stress on the side of the cone. Soil cores also are collected to correlate the CPT readings to the lithologies present at the site.

CPT will be conducted using the USACE's cone penetrometer truck. This equipment consists of an instrument probe that is forced into the ground using a hydraulic load frame mounted on a heavy truck, with the weight of the truck providing the necessary reaction mass. The penetrometer equipment is housed in a stainless steel, dual-compartment body mounted on a 43,000-pound, triple-axle Kenworth[®] truck chassis powered by a turbocharged diesel engine. The weight of the truck and equipment is used as ballast to achieve the overall push capability of 39,000 pounds. This push capacity may be limited in tight soils by the structural bending capacity of the 1.40-inch outside-diameter (OD) push rods, rather than by the weight of the truck. The current 39,000-pound limitation is intended to minimize the possibility of push-rod buckling. Penetration force is supplied by a pair of large hydraulic cylinders bolted to the truck frame.

The penetrometer probe is of standard dimensions, having a 1.40-inch OD, a 60-degree conical point with sacrificial tip, and an 8.0-inch-long by 1.40-inch OD friction sleeve. Inside the probe, two load cells independently measure the vertical resistance against the conical tip and the side friction along the sleeve. Each load cell is a cylinder of uniform cross-section that is instrumented with four strain gauges in a full-bridge circuit. Forces are sensed by the load cells, and the data are transmitted from the probe

assembly via a cable running through the push tubes. The analog data are digitized, recorded, and plotted by computer in the penetrometry truck. A grout tube also runs down the push cylinder to allow the emplacement of cement grout in order to seal the CPT hole. The USACE CPT is not equipped to monitor pore pressure; therefore, the location of the water table will not be measured using the CPT apparatus. However, evaluation of point and sleeve stresses can often provide an estimated depth to groundwater. The penetrometer is usually advanced vertically into the soil at a constant rate of 2 cm/s, although this rate must sometimes be reduced, such as when hard layers are encountered. Penetration, dissipation, and resistivity data will be used to determine lithologic layering as it is encountered in the field.

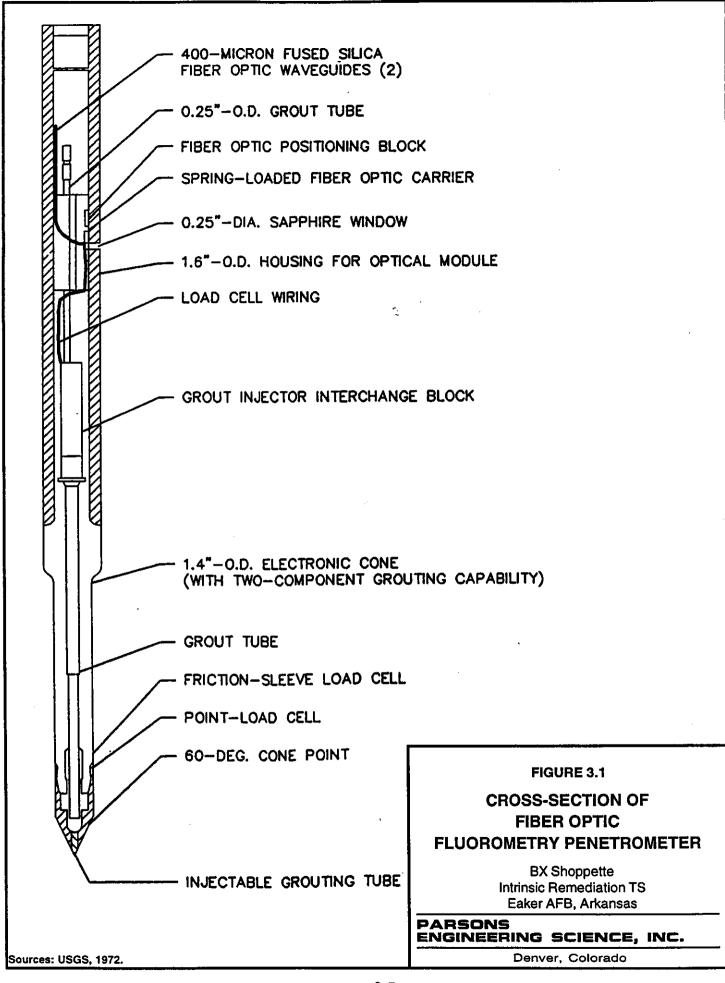
The known propensity of aromatic hydrocarbons to fluoresce under ultraviolet wavelengths has allowed the use of LIF technology, in conjunction with CPT technology, to detect soil characteristics and hydrocarbon contamination simultaneously. The LIF is not capable of detecting chlorinated solvents. The LIF is only useful for more grossly contaminated areas with mobile LNAPL or significant residual contamination concentrations. The lower range of detection is greater than 100 mg/kg total hydrocarbons. The LIF system has a 0.25-inch sapphire window in the side of the cone that allows a laser to scan the soil for fluorescent compounds as the LIF penetrometer rod pushes through soil. Assuming that aromatic hydrocarbons are simultaneously solvenated with other fuel-hydrocarbon constituents, the magnitude of aromatic fluorescence is indicative of hydrocarbon contamination in a soil matrix. Fiber optic cables connected to the laser spectrometer and a 6-pair electrical conductor connected to the CPT data acquisition system, are routed through the interior of the push tubes to the CPT probe.

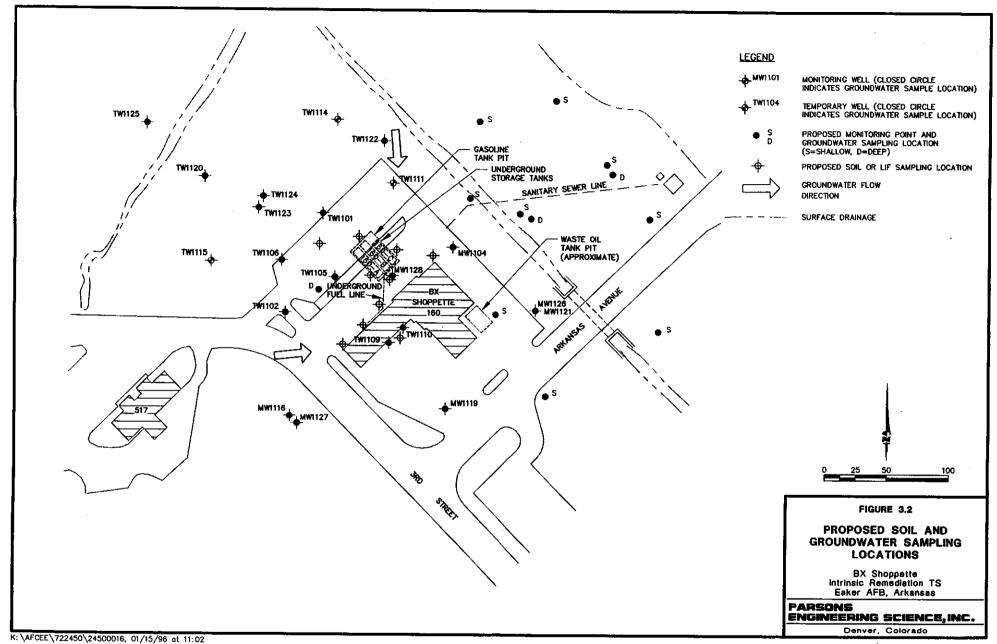
The basic components of the LIF instrument are a nitrogen laser, a fiber optic probe, a monochromator for wavelength resolution of the return fluorescence, a photomultiplier tube to convert photons into an electrical signal, a digital oscilloscope for waveform capture, and a control computer. The fiber optic probe for the cone penetrometer consists of delivery and collection optical fibers, a protective sheath, a fiber optic mount within the cone, and a 0.25-inch sapphire window (Figure 3.1).

The results of each CPT/LIF push will be available 2 or 3 minutes after the completion of each hole. Graphs showing cone resistance, sleeve friction, soil classification, fluorescence intensity, and wavelength will be plotted by USACE personnel at the conclusion of each penetration and presented to the Parsons ES field scientist in order to allow investigative decisions to be based on the most current information.

3.1.1 CPT/LIF Testing Strategy

The purpose of the CPT/LIF testing at the site is to determine subsurface stratigraphy and to better define the areal and vertical extent of residual fuel hydrocarbons in the unsaturated zone and free-phase hydrocarbons in the site groundwater. The CPT will be pushed from ground surface to below fluorescing contamination, refusal, or up to 60 feet bgs, depending on contaminant distribution and subsurface conditions. In order to define the edges of mobile LNAPL contamination, CPT/LIF points be will placed at the locations shown on Figure 3.2. The majority of the points will be used to better define the vertical and lateral extent of the mobile LNAPL layer that has been observed in monitoring well TW1105. Points will be placed at the estimated outer extent of the LNAPL to establish a known mobile LNAPL plume location. CPT/LIF points also will be placed closer or further away, as necessary, to define the extent of the layer. Other CPT/LIF sites are located downgradient from the site across the drainage ditch and will





be used to install monitoring points to collect groundwater BTEX and electron acceptor data. One CPT point will be located north of the site to serve as a background monitoring point. The proposed CPT locations will be repositioned, as needed, based on data collected at the time of field sampling.

Base personnel will coordinate with the USACE to identify the location of all utility lines, USTs, fuel lines, and any other underground infrastructure prior to any CPT activities. All necessary digging permits will be obtained by Base and the USACE personnel prior to mobilizing to the field. Digging permits issued in 1995 for previous USACE (1995) work at the BX Shoppette may be used if Base authorities agree. Base personnel also will coordinate with USACE to acquire drilling and monitoring point installation permits for the proposed CPT/LIF locations indicated in Figure 3.2.

3.1.2 Soil Sampling and Analysis

To check the CPT soil classifications and to calibrate the LIF data, soil samples from discrete intervals will be collected at the site. Soil samples will be collected from varied soil units (if present) within source areas and visibly contaminated areas, at the fringe of the identified residual or mobile LNAPL hydrocarbon plume, and outside of the LNAPL plume. Soil samples will be collected at up to 13 locations. Figure 3.2 shows the locations for 10 proposed sampling locations. In addition, a minimum of three samples will be collected from background or uncontaminated downgradient locations for total organic carbon (TOC) analysis. These sampling locations will be determined by the field scientist based on field data collected using the CPT.

When soil samples are collected using the CPT, a Hoggen-Toggler[®] attachment for the CPT push rods will be used. A Hoggen-Toggler[®] sampler is a device used to collect undisturbed soil samples at any desired depth within the range of the driving apparatus.

The sampler is coupled to the penetrometer rod and pushed into the soil with the CPT truck. With the Hoggen-Toggler® cone in the closed position, soil is prevented from entering the sampling tube until the desired depth is achieved. When the sampler has been pushed to the depth at which the soil sample is to be taken, the sampling unit is raised a few inches and the Hoggen-Toggler® apparatus is opened. The open Hoggen-Toggler® is then pushed to fill with soil, then pulled from the ground as quickly as possible. The Hoggen-Toggler® sampling apparatus allows collection of 8-inch-long by 1-inch inside-diameter (ID) continuous samples. Recovery efficiencies for samples in saturated or sandy soils are often reduced, or the samples are compromised, because of spillage of the soil from the device after extraction. To mitigate this problem, soil samples will be compressed *in situ* with the penetrometer and Hoggen-Toggler® assembly to expel the pore water before extraction.

When the Hoggen-Toggler[®] sampling technique described above is ineffective or unable to efficiently provide sufficient soil volumes for the characterization of the site, soil samples will be obtained using a hand auger or similar method judged acceptable by the Parsons ES field scientist. Procedures will be modified, if necessary, to ensure good sample recovery.

Recovered soil will be placed in analyte-appropriate sample containers (Appendix A) and shipped to an approved analytical laboratory for analysis of BTEX, TOC, moisture content, and TPH by the analytical methods listed in Table 3.1. The lithology of recovered soil will be recorded for comparison and correlation with CPT results.

The Parsons ES field scientist will be responsible for observing all field investigation activities, maintaining a detailed descriptive log of all subsurface materials recovered during soil coring, photographing representative samples, and properly labeling and

storing samples. An example of the proposed geologic boring log form is presented in Figure 3.3. The descriptive log will contain the following information:

- Sample interval (top and bottom depth);
- Sample recovery;
- Presence or absence of contamination based on visual observations, odor, and photoionization detector (PID) headspace measurements;
- Lithologic description, including relative density, color, major textural
 constituents, minor constituents, porosity, relative moisture content, plasticity of
 fines, cohesiveness, grain size, structure or stratification, relative permeability, and
 any other significant observations; and
- Depths of lithologic contacts and/or significant textural changes measured and recorded to the nearest 0.1 foot.

3.1.3 CPT Locations and Datum Survey

The horizontal location of all CPT/LIF testing locations relative to established Base coordinates will be measured by a licensed surveyor. Horizontal coordinates will be measured to the nearest 0.1 foot. The elevation of the ground surface will also be measured to the nearest 0.1 foot relative to a USGS msl datum. Sample location and other relevant site information for the soil cores collected for verification purposes will be recorded by the Parsons ES field scientist.

		GEOLOGI	C BORING LO	<u>)G</u>	Sheet 1 of 1
CLIENT:	AFCEE	_RIG TYPE:	CPT CPT	DATE CMPL.:	
LOCATION:		_BORING DIA.:	NONE	TEMP:	

Elev	Depth	Pro-	บร		S	ample	Sample	Penet		WKSPC	TOTAL	TPH
(ft)	(ft)	file	CS	Geologic Description	No	Depth (ft)	Type	Res	PiD(nom)	PID(nom)	BTEX(ppm)	(ppm)
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NOTES

bgs — Below Ground Surface

GS - Ground Surface

TOC - Top of Casing

NS - Not Sampled

SAA - Same As Above

SAMPLE TYPE

D - DRIVE

C - CORE

G - GRAB

Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

BX Shoppette Intrinsic Remediation TS Eaker AFB, Arkansas

PARSONS

ENGINEERING SCIENCE, INC.

Denver, Colorado

3.1.4 Site Restoration

After sampling is complete, each CPT location will be restored as closely to its original condition as possible. Any test holes remaining open after extraction of the penetrometer rod will be sealed with hydrated bentonite chips, pellets, or grout to eliminate the creation or enhancement of contaminant migration pathways to the groundwater. Soil sampling using the CPT creates minor volumes of soil waste. The accumulated volume of soil waste generated during field activities will be collected in 55-gallon drums or buckets and disposed of at the soil landfarm located on Base.

3.1.5 Equipment Decontamination Procedures

The CPT push rods will be cleaned with potable water using the USACE CPT steam-cleaning system (rod cleaner) as the rods are withdrawn from the ground. A vacuum system located beneath the CPT truck will be used to recover rinseate. Use of this system results in nearly 100-percent recovery of steam-cleaning rinseate from the rod cleaner. Rinseate is generated only as the rods move past the cleaner, thereby minimizing liquid waste generation. Care will be taken not to apply the pressurized steam to the LIF module, which will be decontaminated by hand. Rinseate will be collected in 55-gallon drums. USACE personnel will arrange for final disposal of the containerized rinseate. USACE personnel are responsible for sampling the contents of the drums to identify any hazardous constituents before the drums are transported to an appropriate disposal facility. Other downhole and sampling equipment will be decontaminated by steam cleaning or by the procedures specified in Section 3.3.2.1.

Potable water to be used in CPT equipment cleaning, decontamination, or grouting will be obtained from one of the Base water supplies. Water use approval will be verified by contacting the appropriate facility personnel. The field scientist will make the final

determination as to the suitability of site water for these activities. Precautions will be taken to minimize any impact on the surrounding area that might result from decontamination operations.

3.2 PERMANENT MONITORING POINT INSTALLATION

To further characterize the hydrogeologic conditions of the shallow subsurface, up to 12 groundwater monitoring points may be installed at the site to supplement the existing site monitoring wells. The following sections describe the proposed monitoring point locations and completion intervals, monitoring point installation, monitoring point development, and equipment decontamination procedures.

3.2.1 Monitoring Point Locations and Completion Intervals

The locations of 12 proposed groundwater monitoring points are identified for the BX Shoppette site on Figure 3.2. The proposed locations for the new monitoring points were determined from a review of data gathered during previous site activities. Monitoring point locations were selected to provide hydrogeologic data necessary for successful implementation of the Bioplume II model and to monitor potential fuel hydrocarbon migration from the site. Monitoring point locations were selected to define three aspects of the site: 1) the areal extent of residual and mobile LNAPL contamination, 2) the horizontal and vertical distribution of dissolved BTEX, and 3) the hydrogeology and groundwater flow direction at the site. The proposed locations shown on Figure 3.2 may be modified in the field as a result of encountered field conditions and acquired field data.

Several shallow monitoring points are proposed to define the areal extent of contamination. Eight shallow monitoring points are proposed to be located east of the site to define the lateral extent of the dissolved contaminant migration. At least two deep

monitoring points will be located along the downgradient contaminant flow path to define the vertical extent of BTEX compounds. Another deep point will be placed adjacent to TW1105 to determine if any vertical migration of BTEX is occurring within the mobile LNAPL source area. The final proposed point will be located downgradient of the site near the intersection of the Arkansas and Third Street. Data from this monitoring point will provide additional information on electron acceptor concentrations and define the extent of the BTEX plume.

Screened intervals for shallow monitoring points will extend from approximately 1 foot above the water table to 2 feet below the water table. Deep points will be placed on the basis of lithology, or approximately 10 feet below the next shallowest monitoring point (in the absence of significant lithologic changes). All monitoring points will be installed with 1 meter of screen. The proposed screened intervals of 1 meter will help mitigate the dilution of water samples from potential vertical mixing of contaminated and uncontaminated groundwater in the monitoring point casing, and will give important information on the nature of vertical hydraulic gradients in the area. Adjustments of the depth and length of the screened interval of the monitoring points may be necessary in response to actual aquifer conditions and contaminant stratification identified during LIF/CPT testing.

3.2.2 Monitoring Point Installation Procedures

This section describes the procedures to be used for installation of new groundwater monitoring points. All new monitoring points will be constructed of 0.75-inch OD/0.5-inch ID polyvinyl chloride (PVC) casing placed with a CPT pushrod using equipment described in Section 3.1.

3.2.2.1 Pre-Placement Activities

All necessary digging, drilling, and groundwater monitoring point installation permits will be obtained prior to mobilizing to the field. In addition, all utility lines will be located, and proposed drilling locations will be cleared prior to any intrusive activities. Responsibilities for these permits and clearances are discussed in Section 3.1.1.

Water to be used in monitoring point installation and equipment cleaning will be obtained from one of the Base water supplies. Water use approval will be verified by contacting the appropriate facility personnel. The field scientist will make the final determination as to the suitability of water for these activities.

3.2.2.2 Groundwater Monitoring Point Installation

3.2.2.2.1 Monitoring Point Materials Decontamination

Monitoring point completion materials will be inspected by the field scientist and determined to be clean and acceptable prior to use. If not factory sealed, casing, screen, and casing plugs and caps will be cleaned prior to use with a high-pressure, steam/hot-water cleaner using approved water. Materials that cannot be cleaned to the satisfaction of the field scientist will not be used.

3.2.2.2.2 Monitoring Point Screen and Casing

Groundwater monitoring points will be installed by attaching 0.75-inch OD/0.5-inch ID PVC casing and screen to a sacrificial tip and threading the casing/screen through the penetrometer pushrod. As the pushrod is pressed into the ground, new 0.75-inch OD/0.5-inch ID PVC casing will be continuously attached until the desired depth is reached and a fully cased monitoring point is created. Data collection devices such as CPT and LIF will not be used during monitoring point placement; however, a CPT test will be performed at

each monitoring point location prior to monitoring point placement in order to select desired screen depths.

Monitoring point casing and screens will be constructed of flush-threaded, Schedule 40 PVC. The screens will be factory slotted with 0.01-inch openings. Casing joints will not be glued. The PVC top cap for monitoring points completed at or below grade will not be vented in order to minimize the potential for surface water entering the point.

The field scientist will verify and record the total depth of the monitoring point, the lengths of all casing sections, and the depth to the top of all monitoring point completion materials. All lengths and depths will be recorded to the nearest 0.1 foot. Monitoring point construction details will be noted on a Monitoring Point Installation Record form (Figure 3.4). This information will become part of the permanent field record for the site.

3.2.2.3 Above-Grade and At-Grade Well Completion

Each monitoring point will be completed with an at-grade protective cover. In areas where pavement is present, the at-grade cover will be cemented in place using concrete blended to the existing pavement; otherwise, a concrete pad will be installed around the monitoring point. The concrete immediately surrounding the monitoring point will be sloped gently away from the protective casing to facilitate runoff during precipitation events.

3.2.2.4 Monitoring Point Development

New monitoring points will be developed prior to sampling. Development removes sediment from inside the monitoring point casing and flushes fines from the portion of the formation adjacent to the monitoring point screen.

MONITORING POINT INSTALLATION RECORD JOB NAME EAKER AIR FORCE BASE _____ WELL NUMBER ____ JOB NUMBER 722450.15 INSTALLATION DATE LOCATION ____ GROUND SURFACE ELEVATION _____ DATUM ELEVATION _____ DATUM FOR WATER LEVEL MEASUREMENT _____ _____ SLOT SIZE _____ SCREEN DIAMETER & MATERIAL _____ RISER DIAMETER & MATERIAL _______ BOREHOLE DIAMETER _____ GRANULAR BACKFILL MATERIAL ______ ES REPRESENTATIVE _____ DRILLING METHOD _____ _____ DRILLING CONTRACTOR _____ -VENTED CAP COVER GROUND SURFACE -CONCRETE -THREADED COUPLING -LENGTH OF SOLID RISER: ____ TOTAL DEPTH SOLID RISER ----OF MONITORING LENGTH OF POINT: _____ SCREEN: SCREEN -SCREEN SLOT SIZE: 0.01"___ CAP -LENGTH OF BACKFILLED BOREHOLE: BACKFILLED WITH: _____ FIGURE 3.4 NOT TO SCALE **MONITORING POINT** INSTALLATION RECORD BX Shoppette Intrinsic Remediation TS STABILIZED WATER LEVEL _____ FEET Eaker AFB, Arkansas BELOW DATUM. PARSONS ENGINEERING SCIENCE, INC. Denver, Colorado

Monitoring point development will be accomplished using a peristaltic pump with dedicated tubing provided by Parsons ES. The pump tubing will be regularly lowered to the bottom of the monitoring point so that fines which have accumulated in the bottom are agitated and removed from the monitoring point.

Development will be continued until a minimum 10 casing volumes of water has been removed from the monitoring point and until pH, temperature, specific conductivity, DO, and water clarity (turbidity) stabilize. If the water remains turbid, monitoring point development will continue until the turbidity of the water produced has been stable after the removal of several casing volumes.

A monitoring point development record will be maintained for each point. The monitoring point development record will be completed in the field by the field scientist. Figure 3.5 is an example of the monitoring point development record. Development records will include:

- Monitoring point number;
- Date and time of development;
- Development method;
- Predevelopment water level and monitoring point depth;
- Volume of water produced;
- Description of water produced;
- Postdevelopment water level and monitoring point depth; and
- Field analytical measurements, including pH and specific conductivity.

Pag	e	of

Job Number: 722450.15 Location Eaker AFB - BX Shoppette Well Number	Job Name: AFCEE N by TH\MV Measurement	Date
Pre-Development Information	Time	e (Start):
Water Level:	·	Total Depth of Well:
Water Characteristics		
ColorOdor: None Any Films or Immiscible pH Specific Conductance(µS	Weak Mod Material Temperature(°F °C)	derate Strong
Interim Water Characteristics		
Gallons Removed		
pH		
Temperature (°F °C)		
Specific Conductance(µS/cm)	,	
Post-Development Information	Time	e (Finish):
Water Level:	Tota	l Depth of Well:
Approximate Volume Removed:		
Water Characteristics		
Color Odor: None Any Films or Immiscible pH Specific Conductance(µ	e Material	r Cloudy lerate Strong (°F °C)
Comments:		FIGURE 3.5
		MONITORING POINT DEVELOPMENT RECORD

BX Shoppette Intrinsic Remediation TS Eaker AFB, Arkansas

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Development waters from monitoring points will be collected in buckets at the site because low volumes of purge water are expected. Samples of the development water will be collected in 500- to 1,000-milliliter (mL) plastic or glass jars that are capped with foil and set at ambient temperatures for 15 minutes. A headspace reading of the development water sample will be taken with an organic vapor meter (OVM). Development water with a headspace reading less than 5 parts per million, volume (ppmv) will be released on the ground surface at the site. Development waters with organic vapor headspace readings above 5 ppmv will be collected and transported to the on-base landfarm for disposal.

3.2.2.5 Water Level Measurements

Water levels at existing monitoring wells and newly installed monitoring points will be measured within a short time period so that the water level data are comparable. The depth to water below the measurement datum will be measured to the nearest 0.01 foot using an electric water level probe.

3.2.2.6 Monitoring Point Location and Datum Survey

The location and elevation of the new monitoring points will be surveyed soon after point completion. The horizontal location will be measured relative to established Base coordinates. Horizontal coordinates will be measured to the nearest 0.1 foot. The elevation of the ground surface adjacent to the monitoring point casing and the measurement datum elevation (top of PVC casing) will be measured relative to the USGS msl datum. The ground surface elevation will be measured to the nearest 0.1 foot and the measurement datum, outer casing, and surveyor's pin (if present) elevation will be measured to the nearest 0.01 foot.

3.2.3 Site Restoration

After monitoring point installation and sampling is complete, each site will be restored around the finished monitoring point as closely as possible to its original condition. Both clean and contaminated development waters and sampling purge waters will be stored in 55-gallon drums or buckets. Development water will be disposed of as specified in Section 3.2.2.4.

3.3 GROUNDWATER SAMPLING

This section describes the scope of work required for collection of groundwater quality samples at existing groundwater monitoring wells, monitoring points, and well points. This section also details grab-sampling using peristaltic pumps inserted into the probe rods themselves to obtain single, discrete groundwater samples, if required. All groundwater samples will be obtained using a peristaltic pump and dedicated high-density polyethylene tubing (HDPE) where groundwater levels permit. In order to maintain a high degree of QC during this sampling event, the procedures described in the following sections will be followed.

Sampling will be conducted by qualified scientists and technicians trained in the conduct of groundwater sampling, records documentation, and chain-of-custody procedures. In addition, sampling personnel will have thoroughly reviewed this work plan prior to sample acquisition and will have a copy of the work plan available on site for reference.

The following list summarizes the activities that will occur during groundwater sampling:

• Assembly and preparation of equipment and supplies;

- Inspection of the monitoring well or monitoring point integrity including:
 - Protective cover, cap, and lock,
 - External surface seal and pad,
 - Monitoring point ca, and datum reference, and
 - Internal surface seal;
- Groundwater sampling, including
 - Water level and product thickness measurements,
 - Visual inspection of sample water,
 - Monitoring point casing evacuation, and
 - Sample collection;
- Sample preservation and shipment, including
 - Sample preparation,
 - Onsite measurement of physical parameters, and
 - Sample labeling;
- · Completion of sampling records: and
- Sample disposition.

Detailed groundwater sampling and sample handling procedures are presented in following sections.

3.3.1 Groundwater Sampling Strategy

Groundwater samples will be collected from previously installed monitoring wells and from monitoring points installed during this project. The existing wells and proposed monitoring point locations for sampling are identified in the following sections.

With the exception of wells TW1114 and TW1115, existing monitoring wells TW1101 through MW1128 will be sampled. At monitoring wells MW1124, MW1125, MW1126, MW1127, and MW1128, groundwater samples will be collected from the medium-grained sand unit located approximately 26 feet bgs. Shallow groundwater samples will be collected from the remaining wells. In addition, samples will be collected from the newly installed monitoring points.

3.3.2 Preparation for Sampling

All equipment to be used for sampling will be assembled and properly cleaned and calibrated (if required) prior to arriving in the field. In addition, all record-keeping materials will be gathered prior to leaving the office.

3.3.2.1 Equipment Cleaning

All portions of sampling and test equipment that will contact the sample matrix will be thoroughly cleaned before each use. This includes the CPT rods, water level probe and cable, lifting line, test equipment for onsite use, and other equipment or portions thereof that will contact the samples. Based on the types of sample analyses to be conducted, the following cleaning protocol will be used:

- Wash with potable water and phosphate-free laboratory detergent (HP-II detergent solutions, as appropriate);
- Rinse with potable water;

- Rinse with distilled or deionized water;
- Rinse with isopropyl alcohol; and,
- Air dry the equipment prior to use.

Any deviations from these procedures will be documented in the field scientist's field notebook and on the Groundwater Sampling Record (Figure 3.6).

If precleaned disposable sampling equipment is used, the cleaning protocol specified above will not be required. Laboratory-supplied sample containers will be cleaned and sealed by the laboratory. The type of container provided and the method of container decontamination will be documented in the laboratory's permanent record of the sampling event.

3.3.2.2 Equipment Calibration

As required, field analytical equipment will be calibrated according to the manufacturers' specifications prior to field use. This applies to equipment used for onsite measurements of oxygen, carbon dioxide, pH, electrical conductivity, temperature, alkalinity, reduction/oxidation potential, sulfate, sulfide, nitrate, nitrite, ferrous iron (Fe^{2+}) , total iron, ferric iron $[Fe^{3+} = (total iron) - Fe^{2+}]$, and manganese.

3.3.3 Sampling Procedures

Special care will be taken to prevent contamination of the groundwater and extracted samples. The two primary ways in which sample contamination can occur are through contact with improperly cleaned equipment and through cross-contamination due to insufficient cleaning of equipment between wells and monitoring points. To prevent such contamination, the water level probe and cable used to determine static water levels and

GRUIND A	WATER SAMPLING RECORD - MONITORING W	FI I .
REASON FOATE AND SAMPLE CONTROL	OR SAMPLING: [] Regular Sampling; [] Speci O TIME OF SAMPLING:, 1996 OLLECTED BY: of	(number) al Sampling;a.m./p.m.
OATUM FO	DR WATER DEPTH MEASUREMENT (Describe):_	
MONITOR	ING WELL CONDITION: [] LOCKED:	[] UNLOCKED
·	WELL NUMBER (IS - IS NOT) APPARENT STEEL CASING CONDITION IS: INNER PVC CASING CONDITION IS:	• •
	WATER DEPTH MEASUREMENT DATUM (IS [] DEFICIENCIES CORRECTED BY SAMPLE	
Check-off	EQUIPMENT CLEANED BEFORE USE WITH_ Items Cleaned (List):	
2[]	PRODUCT DEPTH	FT. BELOW DATUM
:		FT. BELOW DATUM
3[]	WATER-CONDITION BEFORE WELL EVACUAPPEARANCE: Odor: Other Comments:	
4[]		
		FIGURE 3.6

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	Monit	oring Well No.	(Cont'd)	
[]	SAMPLE EXTRACTION	METHOD:		
	[] Pump, t	ype:_		
	Sample obtain	ned is [] GRAB; []	COMPOSITE SAMPLE	
[]	ON-SITE MEASUREME	NTS.		
. ,		•	Measured with:	
	pH:		Measured with:	-
	Conductivity	:	Measured with:	
		cygen:	Measured with:	
	Redox Potent	rial:	Measured with:	
	Salinity:		Measured with:	
	Nitrate:		Measured with:	
	Sulfate:		Measured with:	
	Ferrous Iron		Measured with:	
	Other:			
				
3[]	ON-SITE SAMPLE TREA	ATMENT:		
	•		Containers:	
	[] Filtration:		Containers:	
		Method	Containers:	
			Comaniers,	
	[] Preservatives	added:		
		Method	Containers:	
			Containers:	
			Containers:	
		Method		
		17404100		
[]	CONTAINER HANDLIN	G:		
	[] Conta	iner Sides Labeled		
		iner Lids Taped		
	11	iners Placed in Ice Chest		
	[] Conta	mers riacea in rec Chese		
[] 0.	OTHER COMMENTS:			
			·	
	······			

FIGURE 3.6 (Concluded)

GROUNDWATER SAMPLING RECORD

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total well depths will be thoroughly cleaned before and after field use and between uses at different sampling locations according to the procedures presented in Section 3.3.2.1. In addition to the use of properly cleaned equipment, dedicated HDPE tubing will be used at each sampling point, and a clean pair of new, disposable nitrile or latex gloves will be worn each time a different well or monitoring point is sampled. The following paragraphs present the procedures to be followed for groundwater sample collection from groundwater monitoring wells and monitoring points. These activities will be performed in the order presented below. Exceptions to this procedure will be noted in the sampler's field notebook and the groundwater sampling form.

3.3.3.1 Preparation of Location

Prior to starting the sampling procedure, the area around the existing wells and new monitoring points will be cleared of foreign materials, such as brush, rocks, and debris. These procedures will prevent sampling equipment from inadvertently contacting debris around the monitoring well/point.

3.3.3.2 Water Level and Total Depth Measurements

Prior to removing any water from the monitoring well or monitoring point, the static water level will be measured. An electric water level probe will be used to measure the depth to groundwater below the datum to the nearest 0.01 foot. After measuring the static water level, the water level probe will be slowly lowered to the bottom of the monitoring well/point, and the depth will be measured to the nearest 0.01 foot. Based on these measurements, the volume of water to be purged from the monitoring well/point will be calculated. If mobile LNAPL is encountered, the thickness of the LNAPL layer will be measured.

3.3.3.3 Purging Before Sampling

The volume of water contained within the monitoring well/monitoring point casing at the time of sampling will be calculated, and three times the calculated volume will be removed from the well/monitoring point. Clean and contaminated purge waters will be stored in 55-gallon drums or buckets. Water with a headspace reading less than 5 ppmv will be redistributed on the ground surface at the site. Water with headspace readings above 5 ppmv will be collected and transported to the on-Base landfarm for disposal

If a monitoring well/monitoring point is evacuated to a dry state during purging, the monitoring well/monitoring point will be allowed to recharge, and the sample will be collected as soon as sufficient water is present in the monitoring well or monitoring point to obtain the necessary sample quantity. Sample compositing or sampling over a lengthy period by accumulating small volumes of water at different times to obtain a sample of sufficient volume will not be allowed.

3.3.3.4 Sample Extraction

HDPE tubing and a peristaltic pump will be used to extract groundwater samples from the monitoring wells and well points. The tubing will be lowered through the well and 0.75-inch-outside diameter PVC monitoring point casing into the water gently to prevent splashing. The sample will be transferred directly into the appropriate sample container. The water will be carefully poured down the inner walls of the sample bottle to minimize aeration of the sample.

Unless other instructions are given by the analytical laboratory, sample containers will be completely filled so that no air space remains in the container. Excess water collected during sampling will be placed into 55-gallon drums used for monitoring well/monitoring point purge waters and transported for disposal by Base personnel to the on-Base facilities

3.3.4 Onsite Groundwater Parameter Measurement

As indicated on Table 3.1, many of the groundwater chemical parameters will be measured onsite by Parsons ES personnel. Some of the measurements will be made with direct-reading meters, while others will be made using of a Hach[®] portable colorimeter in accordance with specific Hach[®] analytical procedures. These procedures will be described in the following subsections.

All glassware or plasticware used in the analyses will have been cleaned prior to sample collection by thoroughly washing with a solution of Alconox® and water, and rinsing with deionized water and ethanol to prevent interference or cross contamination between measurements. If concentrations of an analyte are above the range detectable by the titrimetric method, the analysis will be repeated by diluting the groundwater sample with double-distilled water until the analyte concentration falls to a level within the range of the method. All rinseate and sample reagents accumulated during groundwater analysis will be collected in glass containers fitted with screw caps. These waste containers will be clearly labeled as to their contents and carefully stored for later transfer by Base personnel to the approved disposal facility.

3.3.4.1 Dissolved Oxygen (DO) Measurements

DO measurements will be made using a meter with a downhole oxygen sensor or a sensor in a flow-through cell. Measurements will be taken before and immediately following groundwater sample acquisition. When DO measurements are taken in monitoring wells/points that have not yet been sampled, the existing monitoring wells/points will be purged until DO levels stabilize. DO measurements will be recorded on the groundwater sampling record (Figure 3.6)

3.3.4.2 pH, Temperature, and Specific Conductance

Because the pH, temperature, and specific conductance of a groundwater sample can change significantly within a short time following sample acquisition, these parameters will be measured in the field in unfiltered, unpreserved, "fresh" water collected by the same technique as the samples taken for laboratory analyses. The measurements will be made in a clean glass container separate from those intended for laboratory analysis, and the measured values will be recorded in the groundwater sampling record (Figure 3.6).

3.3.4.3 Carbon Dioxide Measurements

Carbon dioxide (CO₂) concentrations in groundwater will be measured in the field by experienced Parsons ES scientists via titrimetric analysis using CHEMetrics Method 4500 (0 to 250 mg/L as CO₂). Sample preparation and disposal procedures are the same as outlined at the beginning of Section 3.3.4.

3.3.4.4 Alkalinity Measurements

Alkalinity in groundwater helps buffer the groundwater system against acids generated through both aerobic and anaerobic biodegradation processes. Alkalinity of the groundwater sample will be measured in the field by experienced Parsons ES scientists via titrimetric analysis using USEPA-approved Hach[®] Method 8221 (0 to 5,000 mg/L as calcium carbonate).

3.3.4.5 Nitrate- and Nitrite-Nitrogen Measurements

Nitrate-nitrogen concentrations are of interest because nitrate can act as an electron acceptor during hydrocarbon biodegradation under anaerobic soil or groundwater conditions. Nitrate-nitrogen is also a potential nitrogen source for hydrocarbon-degrading bacteria biomass formation. Nitrite-nitrogen is an intermediate byproduct in both ammonia nitrification and in nitrate reduction in anaerobic environments.

Nitrate- and nitrite-nitrogen concentrations in groundwater will be measured in the field by experienced Parsons ES scientists via colorimetric analysis using a Hach® DR/700 Portable Colorimeter. Nitrate concentrations in groundwater samples will be analyzed after preparation with Hach® Method 8039 (0 to 30.0 mg/L nitrate). Nitrite concentrations in groundwater samples will be analyzed after preparation with USEPA-approved Hach® Method 8507 (0 to 0.35 mg/L nitrite).

3.3.4.6 Sulfate and Sulfide Sulfur Measurements

Sulfate in groundwater is a potential electron acceptor for fuel-hydrocarbon biodegradation in anaerobic environments, and sulfide is resultant after sulfate reduction. The Parsons ES scientist will measure sulfate and sulfide concentrations via colorimetric analysis with a Hach[®] DR/700 Portable Colorimeter after appropriate sample preparation. EPA-approved Hach[®] Methods 8051 (0 to 70.0 mg/L sulfate) and 8131 (0.60 mg/L sulfide) will be used to prepare samples and analyze sulfate and sulfide concentrations, respectively.

3.3.4.7 Total Iron, Ferrous Iron, and Ferric Iron Measurements

Iron is an important trace nutrient for bacterial growth, and different states of iron can affect the oxidation/reduction potential of the groundwater and act as an electron acceptor for biological metabolism under anaerobic conditions. Iron concentrations will be

measured in the field via colorimetric analysis with a Hach® DR/700 Portable Colorimeter after appropriate sample preparation. Hach® Method 8008 for total soluble iron (0 to 3.0 mg/L ferric + ferrous iron) and Hach® Method 8146 for ferrous iron (0 to 3.0 mg/L) will be used to prepare and quantitate the samples. Ferric iron will be quantitated by subtracting ferrous iron levels from total iron levels.

3.3.4.8 Manganese Measurements

Manganese is a potential electron acceptor under anaerobic environments. Manganese concentrations will be quantitated in the field using colorimetric analysis with a Hach[®] DR/700 Portable Colorimeter. EPA-approved Hach[®] Method 8034 (0 to 20.0 mg/L) will be used to prepare the samples for quantitation of manganese concentrations. Sample preparation and disposal procedures are outlined earlier in Section 3.3.4.

3.3.4.9 Reduction/Oxidation Potential

The reduction/oxidation (redox) potential of groundwater is an indicator of the relative tendency of a solution to accept or transfer electrons. Redox reactions in groundwater are usually biologically mediated; therefore, the redox potential of a groundwater system depends upon and influences rates of biodegradation. Redox potential can be used to provide real time data on the location of the contaminant plume, especially in areas undergoing anaerobic biodegradation. The redox potential of a groundwater sample taken inside the contaminant plume should have a redox potential somewhat less than that taken in the upgradient location.

The redox potential of a groundwater sample can change significantly within a short time following sample acquisition and exposure to atmospheric oxygen. As a result, this parameter will be measured in the field in unfiltered, unpreserved, "fresh" water collected by the same technique as the samples taken for laboratory analyses. The measurements will be made as quickly as possible in a clean glass container separate from those intended for laboratory analysis.

3.3.5 Handling of Samples for Laboratory Analysis

This section describes the procedures for sample handling from the time of sampling until the samples arrive at the laboratory.

3.3.5.1 Sample Preservation

The analytical laboratory support personnel will add any necessary chemical preservatives prior to shipping the containers to the site. Samples will be prepared for transportation to the analytical laboratory by placing the samples in a cooler containing ice to maintain a shipping temperature of approximately 4 degrees centigrade (°C). Samples will be delivered to the analytical laboratory via overnight courier so that all sample holding times are met.

3.3.5.2 Sample Container and Labels

Sample containers and appropriate container lids will be provided by the analytical laboratory (see Appendix A). The sample containers will be filled as described in Section 3.3.3.2.4, and the container lids will be tightly closed. The sample label will be firmly attached to the container side, and the following information will be legibly and indelibly written on the label:

- Facility name;
- Sample identification;
- Sample type (e.g., groundwater);
- Sampling date;

- Sampling time;
- Preservatives added;
- Sample collector's initials; and
- Requested analyses.

3.3.5.3 Sample Shipment

After the samples are sealed and labeled, they will be packaged for transport to the mobile laboratory. The following packaging and labeling procedures will be followed:

- Package sample so that it will not leak, spill, or vaporize from its container;
 - Cushion samples to avoid breakage; and
 - Add ice to container to keep samples cool.

The packaged samples will be delivered by overnight courier to the analytical laboratory. Delivery will occur as soon as possible after sample acquisition.

3.3.5.4 Chain-of-Custody Control

After the samples have been collected, chain-of-custody procedures will be followed to establish a written record of sample handling and movement between the sampling site and the analytical laboratory. Each shipping container will have a chain-of-custody form completed in triplicate by the sampling personnel. One copy of this form will be kept by the sampling contractor after sample delivery to the analytical laboratory, and the other two copies will be retained at the laboratory. One of the laboratory copies will become a

part of the permanent record for the sample and will be returned with the sample analytical results. The chain-of-custody will contain the following information:

- Sample identification number;
- Sample collectors' printed names and signatures;
- Date and time of collection;
- Place and address of collection;
- Sample matrix;
- Chemical preservatives added;
- Analyses requested;
- Signatures of individuals involved in the chain of possession; and
- Inclusive dates of possession

The chain-of custody documentation will be placed inside the shipping container so that it will be immediately apparent to the laboratory personnel receiving the container, but will not be damaged or lost during transport. The shipping container will be sealed so that it will be obvious if the seal has been tampered with or broken.

3.3.5.5 Sampling Records

In order to provide complete documentation of the sampling event, detailed records will be maintained by the field scientist. At a minimum, these records will include the following information:

- Sample location (facility name);
- Sample identification;
- Sample location map or detailed sketch;
- Date and time of sampling;
- Sampling method;
- Field observations of
- Sample appearance, and
- Sample odor;
- Weather conditions;
- Water level prior to purging;
- Total monitoring well/monitoring point depth;
- Purge volume;
- Water level after purging;
- Monitoring well/point condition;
- Sampler's identification;
- Field measurements of pH, temperature, DO, and specific conductivity; and
 - Any other relevant information.

Groundwater sampling information will be recorded on a groundwater sampling form. Figure 3.6 shows an example of the groundwater sampling record.

3.3.6 Laboratory Analyses

Laboratory analyses will be performed on all groundwater samples and the QA/QC samples described in Section 5. The analytical methods for this sampling event are listed in Table 3.1. Prior to sampling, arrangements will be made with the analytical laboratory to provide a sufficient number of appropriate sample containers for the samples to be collected. All containers, preservatives, and shipping requirements will be consistent with USEPA protocol or those reported in Appendix A of this plan.

Analytical laboratory support personnel will specify the necessary QC samples and prepare appropriate QC sample bottles. For samples requiring chemical preservation, preservatives will be added to containers by the laboratory prior to delivery to the site. Containers, ice chests with adequate padding, and cooling media may be sent by the laboratory to the site. Sampling personnel will fill the sample containers and return the samples to the laboratory.

3.4 AQUIFER TESTING

Aquifer Slug tests will be conducted on selected existing wells to estimate the hydraulic conductivity of unconsolidated sand and clay deposits at the site. This information is required to accurately estimate the velocity of groundwater and contaminants in the shallow saturated zone. A slug test is a single-well hydraulic test used to determine the hydraulic conductivity of an aquifer in the immediate vicinity of the tested well. Slug tests can be used for both confined and unconfined aquifers that have a transmissivity of less than 7,000 square feet per day (ft²/day). Slug testing can be

performed using either a rising head or a falling head test; at this site, both methods will be used in sequence.

3.4.1 Definitions

- Hydraulic Conductivity (K). A quantitative measure of the ability of porous material to transmit water; defined as the volume of water that will flow through a unit cross-sectional area of porous or fractured material per unit time under a unit hydraulic gradient.
- Transmissivity (T). A quantitative measure of the ability of an aquifer to transmit water. It is the product of the hydraulic conductivity and the saturated thickness.
- Slug Test. Two types of testing are possible: rising head and falling head tests. A slug test consists of adding a slug of water or a solid cylinder of known volume to the well to be tested or removing a known volume of water or cylinder and measuring the rate of recovery of water level inside the well. The slug of a known volume acts to raise or lower the water level in the well.
- Rising Head Test. A test used in an individual well within the saturated zone to
 estimate the hydraulic conductivity of the surrounding formation by lowering the
 water level in the well and measuring the rate of recovery of the water level. The
 water level may be lowered by pumping, bailing, or removing a submerged slug
 from the well.
- Falling Head Test. A test used in an individual well to estimate the hydraulic conductivity of the surrounding formation by raising the water level in the well by insertion of a slug or quantity of water, and then measuring the rate of drop in the water level.

3.4.2 Equipment

The following equipment will be used to conduct a slug test:

- Teflon®, PVC, or metal slugs;
- Nylon or polypropylene rope;
- Electric water level indicator;
- Pressure transducer/sensor;
- Field logbook/forms; and
- Automatic data recording instrument (such as the Hermit Environmental Data Logger[®], In-Situ, Inc. Model SE1000B, or equivalent).

3.4.3 General Test Methods

Aquifer hydraulic conductivity tests (slug tests) are accomplished by either removal of a slug or quantity of water (rising head) or introduction of a slug (falling head), and then allowing the water level to stabilize while taking water level measurements at closely spaced time intervals.

Because hydraulic testing will be completed on existing wells, it will be assumed that the wells were properly developed and that water levels have stabilized. Slug testing will proceed only after multiple submerged pressure transducer measurements over time show that static water levels are in equilibrium. During the slug test, the water level change should be influenced only by the introduction (or removal) of the slug volume. Other factors, such as inadequate well development or extended pumping may lead to

inaccurate results; slug tests will not be performed on wells with free product. The field scientist will determine when static equilibrium has been reached in the well. The pressure transducer, slugs, and any other downhole equipment will be decontaminated prior to and immediately after the performance of each slug test using the procedures described in Section 3.3.2.1.

3.4.4 Falling Head Test

The falling head test is the first step in the two-step slug-testing procedure. The following steps describe procedures to be followed during performance of the falling head test.

- 1. Decontaminate all downhole equipment prior to initiating the test.
- Open the well. Where wells are equipped with water-tight caps, the well should be unsealed at least 24 hours prior to testing to allow the water level to stabilize.
 The protective casing will remain locked during this time to prevent vandalism.
- 3. Prepare the Aquifer Slug Test Data Form (Figure 3.7) with entries for:
 - Borehole/well number,
 - Project number,
 - Project name,
 - Aquifer testing team,
 - Climatic data,
 - Ground surface elevation,

Location Eaker AFB - BX Shoppette Job No	Client AFCEE Field Scientist MV\TH Total Well	Weil No
Depth Measuring Datum Weather	Elevation of Datum	
Comments		

Beginning Time	Ending Time	Initial Head Reading	Ending Head Reading	Test Type (Rise/Fall)	File Name	Comments
						- · · · · · · · · · · · · · · · · · · ·
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FIGURE 3.7

AQUIFER TEST DATA FORM

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- Top of well casing elevation,
- Identification of measuring equipment being used,
- Page number,
- Static water level, and
- Date.
- 4. Measure the static water level in the well to the nearest 0.01 foot.
- 5. Lower the decontaminated pressure transducer into the well and allow the displaced water to return to its static level. This can be determined by periodic water level measurements until the static water level in the well is within 0.01 foot of the original static water level or the submerged pressure-transducer indicates no pressure changes (indicating equilibrium).
- 6. Lower the decontaminated slug into the well to just above the water level in the well.
- 7. Turn on the data logger and quickly lower the slug below the water table, being careful not to disturb the pressure transducer. Follow the owner's manual for proper operation of the data logger.
- 8. Terminate data recording when the water level stabilizes in the well. The well will be considered stabilized for termination purposes when it has recovered 80 to 90 percent from the initial slug.

3.4.5 Rising Head Test

After completion of the falling head test, the rising head test will be performed. The following steps describe the rising-head slug test procedure.

- 1. Measure the water level in the well to the nearest 0.01 foot to ensure that it has returned to the static water level.
- Initiate data recording and quickly withdraw the slug from the well. Follow the owner's manual for proper operation of the data logger.
- 3. Terminate data recording when the water level stabilizes in the well, and remove the pressure transducer from the well and decontaminate. The well will be considered stabilized for termination purposes when it has recovered 80 to 90 percent from the initial slug.

3.4.6 Slug Test Data Analysis

Data obtained during slug testing will be analyzed using AQTESOLVTM and the method of Hvorslev (1951) for confined aquifers or the method of Bouwer and Rice (1976) and Bouwer (1989) for unconfined conditions.

SECTION 4

REMEDIAL OPTION EVALUATION AND TS REPORT

Upon completion of field work, numerical and analytical groundwater models will be used to determine the fate and transport of fuel hydrocarbons dissolved in groundwater at the site. Based upon model predictions of contaminant concentration and distribution through time, and upon potential receptor exposure pathways, the potential risk to human health and the environment will be assessed. If it is shown that intrinsic remediation of BTEX compounds at the sites is sufficient to reduce the potential risk to human health and the environment to acceptable levels, Parsons ES will recommend implementation of the intrinsic remediation option. If intrinsic remediation is chosen, Parsons ES will prepare site-specific, long-term monitoring plans that will specify the location of point-of-compliance monitoring wells and sampling frequencies.

If the intrinsic remediation remedial option is deemed inappropriate for use at this site, institutional controls such as groundwater or land use restrictions will be evaluated to determine if they will be sufficient to reduce the risk to human health and the environment to acceptable levels. If institutional controls are inappropriate, remedial options which could reduce risks to acceptable levels will be evaluated and the most appropriate remedial options will be recommended. Potential remedial options include, but are not limited to, mobile LNAPL recovery, groundwater pump-and-treat, enhanced biological treatment, bioventing, air sparging, and *in situ* reactive barrier walls. The

reduction in dissolved BTEX that should result from remedial activities will be used to produce new input files for the groundwater models. The models will then be used to predict the BTEX plume (and risk) reduction that should result from remedial actions.

Upon completion of modeling and remedial option selection, a TS report detailing the results of the modeling and remedial option selection will be prepared. This report will follow the outline presented in Table 4.1 and will contain an introduction, site description, identification of remediation objectives, description of remediation alternatives, an analysis of remediation alternatives, and the recommended remedial approach for the site. This report will also contain the results of the site characterization activities described herein and a description of the models developed for the site.

TABLE 4.1 EXAMPLE TS REPORT OUTLINE BX SHOPPETTE INTRINSIC REMEDIATION TS EAKER AFB, ARKANSAS

INTRODUCTION

Scope and Objectives Site Background

SITE CHARACTERIZATION ACTIVITIES

Sampling and Aquifer Testing Procedures

PHYSICAL CHARACTERISTICS OF THE STUDY AREA

Surface Features Regional Geology and Hydrogeology Site Geology and Hydrogeology Climatological Characteristics

NATURE AND EXTENT OF CONTAMINATION

Source Characterization

Soil Chemistry

Residual Contamination

Total Organic Carbon

Ground Water Chemistry

LNAPL Contamination

Dissolved Contamination

Ground Water Geochemistry

Expressed Assimilative Capacity

GROUND WATER MODEL

Model Description

Conceptual Model Design and Assumptions

Initial Model Setup

Model Calibration

Sensitivity Analysis

Model Results

Conclusions

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Remedial Alternative Evaluation Criteria

Long-Term Effectiveness

Implementability (Technical, Administrative)

Cost (Capital, Operating, Present Worth)

Factors Influencing Alternatives Development

Program Objectives

Contaminant Properties

Site-Specific Conditions

Brief Description of Remedial Alternatives

Intrinsic Remediation with Long-Term Monitoring

Other Alternatives

Evaluation of Alternatives

Recommended Remedial Approach

TABLE 4.1 (Concluded) EXAMPLE TS REPORT OUTLINE BX SHOPPETTE INTRINSIC REMEDIATION TS EAKER AFB, ARKANSAS

LONG-TERM MONITORING PLAN

Overview
Monitoring Networks
Ground Water Sampling

CONCLUSIONS AND RECOMMENDATIONS

APPENDICES: Supporting Data and Documentation
Site-Specific Bioplume II Model Input and Results

SECTION 5

QUALITY ASSURANCE/QUALITY CONTROL

Field QA/QC procedures will include collection of field replicates and duplicates and rinseate, field and trip blanks; decontamination of all equipment that contacts the sample medium before and after each use; use of analyte-appropriate containers; and chain-of-custody procedures for sample handling and tracking. All samples to be transferred to the analytical laboratory for analysis will be clearly labeled to indicate sample number, location, matrix (e.g., groundwater), and analyses requested. Samples will be preserved in accordance with the analytical methods to be used, and water sample containers will be packaged in coolers with ice to maintain a temperature of as close to 4°C as possible.

All field sampling activities will be recorded in a bound, sequentially paginated field notebook in permanent ink. All sample collection entries will include the date, time, sample locations and numbers, notations of field observations, and the sampler's name and signature. Field QC samples will be collected in accordance with the program described below, and as summarized in Table 5.1.

QA/QC sampling will include collection and analysis of duplicate groundwater and replicate soil samples, rinseate blanks, field/trip blanks, and matrix spike samples. Internal laboratory QC analyses will involve the analysis of laboratory control samples (LCSs) and laboratory method blanks (LMBs). QA/QC objectives for each of these samples, blanks, and spikes are described below.

TABLE 5.1 QA/QC SAMPLING PROGRAM BX SHOPPETTE INTRINSIC REMEDIATION TS EAKER AFB, ARKANSAS

QA/QC Sample Types	Collection/Analysis	Analytical Methods
Duplicates/Replicates	3 Groundwater and 2 Soil Samples (10%)	VOCs, TPH
Rinseate Blanks	1 Sample	VOCs
Field Blanks	1 Sample	VOCs
Trip Blanks	One per shipping cooler containing VOC samples	VOCs
Matrix Spike Samples	Once per sampling event	VOCs
Laboratory Control Sample	Once per method per medium	Laboratory Control Charts (Method Specific)
Laboratory Method Blanks	Once per method per medium	Laboratory Control Charts (Method Specific)

Only one rinseate sample will be collected at the site because dedicated tubing will eliminate the potential for cross-contamination due to improper decontamination of sampling tubing. Rinseate samples will consist of a sample of distilled water poured into or pulled through decontaminated or new sampling equipment and subsequently transferred into a sample container provided by the laboratory. Rinseate samples will be analyzed for VOCs only.

A field blank will be collected to assess the effects of ambient conditions in the field. The field blank will consist of a sample of distilled water poured into a laboratory-supplied sample container while sampling activities are underway. The field blank will be analyzed for VOCs.

A trip blank will be analyzed to assess the effects of ambient conditions on sampling results during the transportation of samples. The trip blank will be prepared by the laboratory. A trip blank will be transported inside each cooler which contains samples for VOC analysis. Trip blanks will be analyzed for VOCs.

Matrix spikes will be prepared in the laboratory and used to establish matrix effects for samples analyzed for VOCs. LCSs and LMBs also will be prepared internally by the laboratory and will be analyzed each day that samples from the site are analyzed. Samples will be reanalyzed in cases where the LCS or LMB are out of the control limits. Control charts for LCSs and LMBs will be developed by the laboratory and monitored for the analytical methods used.

SECTION 6

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APPENDIX A

CONTAINERS, PRESERVATIVES, PACKAGING, AND SHIPPING

REQUIREMENTS FOR GROUNDWATER SAMPLES

TABLE A.1 SAMPLE PACKAGING AND HANDLING REQUIREMENTS

BX Shoppette

Intrinsic Remediation TS

Eaker AFB, Arkansas

Matrix	Analysis	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Soil	Volatile organics	Gas chromatography/ mass spectrometry method SW8240.	Handbood method	Data is used to determine the extent of chlorinated solvent and aromatic hydrocarbon contamination, contaminant mass present, and the need for source removal	Each sampling round	Collect 100 g of soil in a glass container with Teflon®-lined cap; cool to 4°C	Fixed-base
Soil	Dehydrogenase enzyme activity (optional)	Colorimetric RSKSOP-100	Reduction of added triphenyltetrazolium chloride by soil microbes is measured colorimetrically; analyze immediately	An indicator of the presence of soil microbes, which are necessary for bioremediation to occur	At the beginning of the project	Collect 100 g of soil in a glass container	Field
Soil	Aromatic hydrocarbons (benzene, toluene, ethyl- benzene, and xylene [BTEX]; trimethylbenzene isomers)	Purge and trap gas chromatography (GC) method SW8020	Handbook method modified for field extraction of soil using methanol	Data is used to determine the extent of soil contamination, the contaminant mass present, and the need for source removal	Each sampling round	Collect 100 g of soil in a glass container with Teflon-lined cap; cool to 4°C	Fixed-base
Soil	Total hydrocarbons, volatile and extractable	GC method SW8015 [modified]	Handbook method; reference is the California LUFT manual	Data are used to determine the extent of soil contamination, the contaminant mass present, and the need for source removal	Each sampling round	Collect 100 g of soil in a glass container with Teflon-lined cap; cool to 4°C	Fixed-base

TABLE A.1Continued) SAMPLE PACKAGING AND HANDLING REQUIREMENTS BX Shoppette Intrinsic Remediation TS

Eaker AFB, Arkansas

Matrix	Analysis	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Soil	Total organic carbon (TOC)	SW9060 modified for soil samples	Procedure must be accurate over the range of 0.5-15 percent TOC	Relatively high amounts of TOC may be indicative of a reducing environment and may indicate the need for analysis of electron acceptors associated with that environment; the rate of migration of petroleum contaminants in groundwater is dependent upon the amount of TOC in the saturated zone soil; the rate of release of petroleum contaminants from the source into groundwater is dependent (in part) on the amount of TOC in the vadose zone soil	At initial sampling	Collect 100 g of soil in a glass container with Teflon-lined cap; cool to 4°C	Fixed-base
Soil	Moisture	ASTM D-2216	Handbook method	Data are used to correct soil sample analytical results for moisture content (e.g., report results on a dry weight basis)	Each soil sampling round	Use a portion of soil sample collected for another analysis	Fixed-base
Soil	Grain size distribution	ASTM D422	Procedure provides a distribution of grain size by sieving	Data are used to infer hydraulic conductivity of aquifer, and are used in calculating sorption of contaminants	One time during life of project	Collect 250 g of soil in a glass or plastic container, preservation is unnecessary	Fixed-base
Soil gas	Carbon dioxide content of soil gas	Nondispersive infrared instrument operating over the range of approximately 0.1–15 percent	Soil gas carbon dioxide may be produced by the degradation of petroleum hydrocarbons	Data used to understand the carbon dioxide concentration gradient with depth and to infer the biological degradation of petroleum contaminants	Each sampling round	N/A	Field

TABLE A.1Continued) SAMPLE PACKAGING AND HANDLING REQUIREMENTS BX Shoppette

Intrinsic Remediation TS Eaker AFB, Arkansas

Matrix Soil gas	Analysis Oxygen content	Method/Reference Electrochemical oxygen	Comments The concentration	Data Use Data are used to	Recommended Frequency of Analysis Each sampling	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory Field
	of soil gas	meter operating over the range of 0 25 percent of oxygen in the soil gas sample	of soil gas oxygen is often related to the amount of biological activity, such as the degradation of petroleum hydrocarbons; soil gas oxygen concentrations may decrease to the point where anaerobic pathways dominate	understand the oxygen concentration gradient with depth and to determine the presence or absence of aerobic degradation processes	round		
Soil gas	Methane content of soil gas	Total combustible hydrocarbon meter using a platinum catalyst with a carbon trap, and operating in the low parts per million volume (ppmv)	Methane is a product of the anaerobic degradation of petroleum hydrocarbons	Soil gas methane can be used to locate contaminated soil and to determine the presence of anaerobic processes, see discussion of data use for methane in water	Each sampling round	N/A	Field
Soil gas	Fuel hydrocarbon vapor content of soil gas	range Total combustible hydrocarbon meter operating over a wide ppmv range	Soil gas hydrocarbons indicate the presence of these contaminants in the soil column	Data used to understand the petroleum hydrocarbon concentration gradient with depth and to locate the most heavily contaminated soils	Fach sampling round	N/A	Field
Water	Ferrous (Fe ⁺²)	Colorimetric A3500-Fe D	Pield only	May indicate an anaerobic degradation process due to depletion of oxygen, nitrate; and manganese	Each sampling round	Collect 100 mL of water in a glass container, acidify with hydrochloric acid per method	Field

TABLE A.1Continued) SAMPLE PACKAGING AND HANDLING REQUIREMENTS BX Shoppette

Intrinsic Remediation TS Eaker AFB, Arkansas

Analysis	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Ferrous (Fe ⁺²)	Colorimetric HACH Method # 8146	Alternate method; field only	Same as above	Each sampling round	Collect 100 mL of water in a glass container	Field
Total Iron	Colorimetric HACH Method # 8008	Field only		Each sampling round	Collect 100mL of water in a glass constainer	Field
Manganese	Colorimetric HACH Method # 8034	Field only		Each sampling round	Colect 100 mL of water	Field
Chloride	Mercuric nitrate titration A4500-Cl ⁻ C	Ion chromatography (IC) method E300 or method SW9050 may also be used	General water quality parameter used as a marker to verify that site samples are obtained from the same groundwater system	Each sampling round	Collect 250 mL of water in a glass container	Field
Chloride	HACH Chloride test kit model 8-P	Silver nitrate titration	Same as above	Each sampling round	Collect 100mL of water in a glass container	Field
Oxygen	Dissolved oxygen meter	Refer to method A4500 for a comparable laboratory procedure	The oxygen concentration is a data input to the Bioplume model; concentrations less than I mg/L generally indicate an appropriate pathway.	Each sampling round	Collect 300 mL of water in biochemical oxygen demand bottles; analyze immediately, alternately, measure	Field
Conductivity	E120.1/SW9050, direct reading meter	Protocols/Handbook methods	General water quality parameter used as a marker to verify that site samples are obtained from the same groundwater system	Each sampling round	Collect 100-250 mL of water in a glass or plastic container	Field
Alkalinity	HACH Alkalinity test kit model AL AP MG-L	Phenolphtalein method	General water quality parameter used (1) as a marker to verify that all site samples are obtained from the same groundwater system and (2) to measure the buffering capacity of	Each sampling round	Collect 100mL of water in glass container	Field
	Ferrous (Fe ⁺²) Total Iron Manganese Chloride Chloride Oxygen	Ferrous (Fe*2) Colorimetric HACH Method # 8146 Total Iron Colorimetric HACH Method # 8008 Colorimetric HACH Method # 8034 Chloride Chloride Chloride Chloride HACH Chloride test kit model 8-P Dissolved oxygen meter Conductivity E120.1/SW9050, direct reading meter Alkalinity HACH Alkalinity test	Ferrous (Fe*2) Colorimetric HACH Method # 8146 Colorimetric HACH Method # 8008 Manganese Colorimetric HACH Method # 8034 Chloride Chloride	Ferrous (Fe*2) Colorimetric HACH Method # 8146 Total Iron Colorimetric HACH Method # 8008 Colorimetric HACH Method # 8008 Colorimetric HACH Method # 8034 Chloride Chloride	Analysis Method/Reference Comments Data Use Frequency of Analysis Colorimetric HACH Method # 8146 Total Iron Colorimetric HACH Method # 8008 Field only Field only Field only General water quality parameter used as a marker to verify that site samples are obtained from the same groundwater system Conductivity Conductivity E120 1/SW9050, direct reading meter Conductivity Frequency of Analysis Alternate method; field only Field only Field only General water quality parameter used as a marker to verify that site samples are obtained from the same groundwater system General water quality pround Each sampling round Each sampling round Each sampling round The oxygen concentration is a data input to the Bioplume model; occentrations less than I mg/L generally indicate an anaerobic pethway General water quality parameter used as a marker to verify that site samples are obtained from the same groundwater system General water quality parameter used as a marker to verify that all site samples are obtained from the same groundwater system and (2) to measure; the buffering capacity of	Analysis Method/Reference Ferrous (Fe*1) Colorimetric HACH Method # 8146 Total Iron Manganese Colorimetric HACH Method # 8008 Colorimetric Hach Hach Method # 8008 Colorimetric Hach Hach Hach Hach Hach Hach Hach Hac

TABLE A.1Continued) SAMPLE PACKAGING AND HANDLING REQUIREMENTS BX Shoppette

Intrinsic Remediation TS Eaker AFB, Arkansas

Matrix	Analysis	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Water	Alkalinity	A2320, titrimetric; E310.2, colorimetric	Handbook method	Same as above	Each sampling round	Collect 250 mL of water in a glass or plastic container, analyze within 6 hours	Field
Water	Nitrate (NO ₃ -1)	IC method E300 or method SW9056; colorimetric, method E353.2	Method E300 is a Handbook method; method SW9056 is an equivalent procedure	Substrate for microbial respiration if oxygen is depleted	Each sampling round	Collect up to 40 mL of water in a glass or plastic container, cool to 4°C; analyze within 48 hours	Fixed-base
Water	Nitrate (NO ₃ -1)	HACH method # 8039 for high range method # 8192 for low range	Colorimetric	Same as above	Each sampling round	Collect 100mL of water in a glass container	Field
Water	Nitrite (NO	HACH method #8040	Colonimetric	Substrate for microbial respiration if oxygen is depleted	Each sampling round	Collect 100mL of water in a glass container	Field
Water	Sulfate (SO ₄ -2)	IC method E300 or method SW9056	Method E300 is a Handbook method; method SW9056 is an equivalent procedure	Substrate for anaerobic microbial respiration	Each sampling round	Collect up to 40 mL of water in a glass or plastic container, cool to 4°C	Fixed-base
Water	Sulfate (SO ₄ -2)	HACH method # 8051	Colonmetric	Same as above	Each sampling round	Collect up to 40 mL of water in a glass or plastic container; cool to 4°C	Field
Water	Dissolved sulfide (S ⁻²)	HACH method # 8131	Colorimetric	Product of sulfate-based anaerobic microbial respiration; analyze in conjunction with sulfate analysis	Each sampling round	Collect 100 mL of water in a glass container, analyze immediately	Field

TABLE A.1Continued) SAMPLE PACKAGING AND WANDLING REQUIREMENTS

BX Shoppette Intrinsic Remediation TS Eaker AFB, Arkansas

Matrix	Analysis	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Vater	Ethane, ethene	RSKSOP-114 (cont'd)	Ethane and ethene are analyzed in addition to the other analytes only if chlorinated hydrocarbons are contaminants suspected of undergoing biological transformation	Ethane and ethene are products of the biotransformation of chlorinated hydrocarbons under anaerobic conditions. The presence of these chemicals may indicate that anaerobic degradation is occurring			
Vater	Carbon dioxide	HACH test kit model CA-23 or CHEMetries Method 4500	Titrimetric; alternate method	The presence of free carbon dioxide dissolved in groundwater is unlikely because of the carbonate buffering system of water, but if detected, the carbon dioxide concentrations should be compared with background to determine whether they are elevated; elevated concentrations of carbon dioxide could indicate an aerobic mechanism for bacterial	Each sampling round	Collect 100 mL of water in a glass container	Field

TABLE A.1Continued) SAMPLE PACKAGING AND HANDLING REQUIREMENTS BX Shoppette Intrinsic Remediation TS

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Matrix	Analysis	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Water	Aromatic hydrocarbons (BTEX, trimethylbenzene isomers)	Purge and trap GC method SW8020	Handbook method; analysis may be extended to higher molecular weight alkyl benzenes	Method of analysis for BTEX, which is the primary target analyte for monitoring natural attenuation; BTEX concentrations must also be measured for regulatory compliance; method can be extended to higher molecular weight alkyl benzenes, trimethylbenzenes are used to monitor plume dilution if degradation is primarily anaerobic	Each sampling round	Collect water samples in a 40 mf. VOA vial; cool to 4°C; add hydrochloric acid to pH 2	Fixed-base
Water	Total hydrocarbons, volatile and extractable	GC method SW8015 [modified]	Handbook method; reference is the California LUFT manual	Data used to monitor the reduction in concentrations of total fuel hydrocarbons (in addition to BTEX) due to natural attenuation; data also used to infer presence of an emulsion or surface layer of petroleum in water sample, as a result of sampling	One time per year or as required by regulations	Volatile hydrocarbons—collect water samples in a 40 mL VOA vial; cool to 4°C; add hydrochloric acid to pH 2 Extractable hydrocarbons—collect 1 L of water in a glass container; cool to 4°C; add hydrochloric acid to pH 2	Fixed-base
Water	Polycyclic aromatic hydrocarbons (PAHs) (optional)	GC/mass spectroscopy method SW8270; high-performance liquid chromatography method SW8310	Analysis needed only for several samples per site	PAHs are components of fuel and are typically analyzed for regulatory compliance; data on their concentrations are not used currently in the evaluation of natural attenuation	At initial sampling and at site closure or as required by regulations	Collect I L of water in a glass container, cool to 4°C	Fixed-base

TABLE A.1Continued) SAMPLE PACKAGING AND HANDLING REQUIREMENTS

BX Shoppette Intrinsic Remediation TS Eaker AFB, Arkansas

Matrix	Analysis	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Water	Total fuel carbon (optional)	Purge and trap GC method SW8020 modified to measure all volatile aromatic hydrocarbons present in the sample	A substitute method for measuring total volatile hydrocarbons; reports amount of fuel as carbon present in the sample; method available from the U.S. EPA Robert S.	Data used to monitor the reduction in concentrations of total fuel hydrocarbons (in addition to BTEX) due to natural attenuation	At initial sampling and at site closure	Collect 40 mL of water in glass vials with Teflon-lined caps; add sulfuric acid to pH 2; cool to 4°C	Fixed-base
Water	Volatile Organics	GS/MS method SW8240	Kerr Laboratory Handbook method	Method of analysis for chlorinated solvents and aromatic hydrocarbons for evaluation of cometabolic degradation; measured for regulatory compliance when chlorinated solvents are known site contaminants	Each sampling round	Collect water samples in a 40 mL VOA vial; cool to 4°C; add hydrochloric acid to pH 2	Fixed-base
Water	Dissolved organic carbon (DOC) (optional)	A5310 C	An oxidation procedure whereby carbon dioxide formed from DOC is measured by an infrared spectrometer. The minimum detectable amount of DOC is 0.05 mg/L	An indirect index of microbial activity	Each sampling round	Collect 100 mL of water in an amber glass container with Teflonlined cap; preserve with sulfuric acid to pH less than 2; cool to 4°C	Fixed-base
Water	pH	E150.1/SW9040, direct reading meter	Protocols/Handbook methods	Aerobic and anaerobic processes are pH-sensitive	Each sampling round	Collect 100-250 mL of water in a glass or plastic container, analyze immediately	Field

TABLE A.1Continued) SAMPLE PACKAGING AND HANDLING REQUIREMENTS BX Shoppette

Intrinsic Remediation TS Eaker AFB, Arkansas

Matrix	Analysis	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Water	Temperature	E170.1	Field only	Well development	Each sampling round	N/A	Field
Water	Redox potential	A2580 B	Measurements are made with electrodes; results are displayed on a meter, samples should be protected from exposure to atmospheric oxygen	The redox potential of groundwater influences and is influenced by the nature of the biologically mediated degradation of contaminants; the redox potential of groundwater may range from more than 200 mV to less than -400 mV	Each sampling round	Collect 100-250 mL of water in a glass container, filling container from bottom; analyze immediately	Field

TABLE A.1Continued) SAMPLE PACKAGING AND HANDLING REQUIREMENTS

BX Shoppette Intrinsic Remediation TS Eaker AFB, Arkansas

NOTES:

- 1. "HACH" refers to the HACH Company catalog, 1990.
- 2. "A" refers to Standard Methods for the Examination of Water and Wastewater, 18th edition, 1992.
- 3. "E" refers to Methods for Chemical Analysis of Water and Wastes, U.S. Environmental Protection Agency, March 1979.
- 4. "Protocols" refers to the AFCEE Environmental Chemistry Function Installation Restoration Program Analytical Protocols, 11 June 1992.
- 5. "Handbook" refers to the AFCEE Handbook to Support the Installation Restoration Program (IRP) Remedial Investigations and Feasibility Studies (RI/FS), September 1993.
- 6. "SW" refers to the Test Methods for Evaluating Solid Waste, Physical, and Chemical Methods, SW-846, U.S. Environmental Protection Agency, 3rd edition, 1986.
- 7. "ASTM" refers to the American Society for Testing and Materials, current edition.
- 8. "RSKSOP" refers to Robert S. Kerr (Environmental Protection Agency Laboratory) Standard Operating Procedure.
- 9. "LUFT" refers to the state of California Leaking Underground Fuel Tank Field Manual, 1988 edition.
- 10. International Journal of Environmental Analytical Chemistry, Volume 36, pp. 249-257, "Dissolved Oxygen and Methane in Water by a Gas Chromatography Headspace Equilibration Technique," by D. H. Kampbell, J. T. Wilson, and S. A. Vandegrift.

APPENDIX B ADDITIONAL SITE DATA

APPENDIX B - 1A

SOIL BOREHOLE LOGS

BX SHOPPETTE

Source: Halliburton NUS 1992, 1994, and 1995.



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<u>نا</u> ز	1	口	171	19		 	0		1		CLAY; VERY MOIST PLASTIC SOFT
ŧ		ノ	16.0	78.12	٥	(c2)	-				GROY - NE GROY . MINOR SILT
ş ç	~		l	12	EIIOI	(E)				<u></u>	6-5 - 30.0'
				1 7	14						
		-		+	-						CLAY AS ABOVE; FUEL COOR
-	=		e video.		17 Transport	4-6	حهاد	4-		E	CLAY AS ABOVE , FACOUVE
2000		ļ		1		111			Ho		
<u>کلا</u> -	7	- !		EYC (11 COV)	2-	13.7	4	CL	H	_	
닐	2]	5	二二	ج	-	たこ	1	10-	H9	-	1
립	7	J	リノ	Į ÿ	E1101	250	2 90		Ц-	` -	
الم	-		l,	2	I I	ے بال	1"	l	\sqcup_{io}	,l` -	-

F	-11	EL	D	L(<u> DG</u>	0	F	BC	R	N	G (CONT'D.) SHEET 7 OF 2
	E	FEET DRIVEN	OVERED	PLEDITION	<u>بر</u> د	ED LAB.	IUSCAN	LITHOLOGIC	DEPTH (FEET)		PROJECT BORING NO. EAKER JOB NO. 3K98 TW1(0)
							50			-	
CANT SPLIT		5	5	בארפורפות	É-101-3	0802	4 2 5	선당	13	1 11 11	CLAY AS ABOVE MINER SILT PUST LT GROVE MOTTLED, TRACE MINOR REBANICS (WOOD FRANS) OR OXIDE SLIGHT FUEL COOR NONLES
SPON		5	5	EXCELENT	h-10113	2,80	0	상	18 19 20 21		CLAY AS ABOVE; Driller will put on solid anger and
STRAIGH T	22 - 30'			_					25 24 25 26 27 28 29		DRILLER PEPORTS DRILLING CLAY TO 30' TO REPULLED @ 0827
÷					<i>y</i>		etros,	94°C-1	1 2 3 4 5 6	y. *.	
N(- TC	ES:	la l	2 12					0		



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Ī	-1E) 	ما	G	OF	- E	30	RII	NG	SHEET 1 OF 2
ſ	PLAI	N T			1						PROJECT EAKER BORING NO.
			51	MTID	٧ 				•		3K98 BX TW1102
1											JOB NO. 3K98 LOGGED BY: JSB
											PROJ. MGR. GVG EDITED BY: BEN
١		,									DRILLING COMPANY: AW POOL
		ſ	Paris) AREA	T.			# 1	1	WIL	2	DRILL RIG TYPE: MOBILE B-61
		(رت)	0)	DRILLING METHOD: Howard Stom Ands
Ì	12								9	./	DRILLERS NAME: V. BARAZZA .
	V	•									TOTAL DEPTH (FT.) 30
			0			<u></u>)	TIME 0945 DATE (2/1) 91
ļ		<u> </u>	w.10	<u>8)</u>		-			1		COMPLETED 1738 DATE 12/1/19/
.					A K	SE SE					GROUND-WATER CONDITION AT COMPLETION OF DRILLING Saturated Education 7.5' and 18'
١					ABE SEE	ABE			1		
	~		잁	Z	82		Z	<u> </u>			BACKFILLED. DATE - SEE COMPLETION FR. WEATHER CONDITIONS
	LER		. ÿ	買	Z'E	74	SCA)	9	F		CLEAR, 50°, SL. BREEZE
	35			ZZ	FIEL D Sampl	AKE	32		교		SURFACE
	Ø►.	ᄄᅙ	<u>Læ</u>	w C	FI S	SA	I	70		162	ELEVATION
취	<u>۾</u>				·				H	10.00	COMMENTS ASPHALT AS EURFACE
316	7 C.	7	0	l	1	1	1		H′	٥	
Sng	40	4							H	FM	Fill: Clay don't black to stay
_									+ 2	-3-	moist on some small crowd clusts
(_	' : :					!	5		H	- ,	Clay brown, moist meeting stiff
7	i								3	-	plostic ul same selt , trace of
V				-	N	N		CL	H	-]	See of
2	0			3		ě	6		H	\ '-`	
Connucce	50000 - 7	_		۱	-	9,			H_{-}	1,0	
Ş	9,1	C	ン	[B	22				Π^s	· -	
5	N			N SE	£1102					-	
3				4	l h				∐•	- 1-	
i Tage		-									158 (2/4)
. ,				1	77		-/		1978 76.		DAND STRINGER by 7-7.5' SATURATED
		-			=	2					W) PHICK
00	12 4	_		4		8		-	Ц	;-	
	0.	14	7	76,77	2	11			L	- '	CLAY; BROWN MOIST, BOFT - MD. STIE
í	3 37	ا ا	٧ [ή ζ	02		7	5	Щ.,	' -	PLASTIC. SOME SILT. MOTTLED W
	ונ	1	l	l		1			U.,		RESDISH - GRAY MOTTLES.

F	-[[EL	D	L(<u>) G</u>	0	F	BC	R	IN	G (CONT'D.) SHEET 20F 2
	۲ ا	FEET DRIVEN	Ð	1	FIELD LAB. SAMPLE NO	ED LAB.	HNUSCAN (PPM)	L/THOLOGIC CODE	DEPTH (FEET)		PROJECT EAKER BX BORING NO. JOB NO. 3K98 TWILOZ
							11		,,		CLAY AS ABOVE
Car Spir	12-17	5	5	ekcenessi	J	[7 7 7	СН	13 14 15 16	1-1-1-1	PLASTIC. THER BROWN THAN ABOVE BARREL WET AT 18'
CONT SPLIT	17-22	5	5	ekenent	E1102-3 (18)	72018	0 4 5 5	CH	18		CLAY AS ABOVE; SOFT-MED.STIFF-STIFF AT BOTTOM; SOME SILT; MOTTLED BROWN-GIY RED BROWN. DRILLER WILL INSURT CENTERS BIT TO
STRAIGHT	08 - 22	1	1	1	(3 4 5 6 7 8 9 30		FINISH HALE
					41.7.2.4	***			2 3 4 5 6 7		
NC	TE	S:							- 5	<u>-</u>	



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CONT SPUT SPOON 7-1	2	CONT	1 N U C (L)	s spc		,		RAIG		IY		ER			1	Ŋ					٠	: 1		PL A!	
5		*	5				t) - Z	-		<u>IVEI</u>	1	·		∦ `	٢	<u></u>								Ľ
.5	erena a	4	3					٥			COV		ED						·				PCAS		
GOOD			6000							CO	MPL NOI	<u> 101</u>											b		b
E1103-2 (10°	(i)	E 11	03 -((3')	@ 1	3 c Z		_		SA	MPL.	EN	IUME			٦	0	1							ကြ
E11-54-TW1103			su- T			(3')		-	FIX	KED MPL	E N	ORA NMB	TORY ER			CANOP								유
(10') @ 13 OC	305	@ 1	302 0	,	2	482			<u>.</u>	HN (P)	U S(PM)	CAN					٦,					*			QU
° ° C			V.		C					Lii CO	HOI	.OG	IC			L		_l							K
							No	Ļ			PTH)		•			ම	Twu03							2
				- C C	,	1	1 7	; (113	_		!				FOR		<u>. ŭ</u>						<i>i</i>]	RING
	1 1	,		1 1	1	11	- 	Ė	8			S	12	89	18		-	2	9 1		2]]	हा हि	<u> </u>	# 2	U ,
	,						5			SURFACE	WARM	ATHER	BACKFILLED.	COMPLETION (TIME TAXTED	TOTAL	ORILLERS	DRILLING METHOD:	DAN I RIG	THOU WIGHT GA G	JOB NO.	SHOPPET	PROJECT	
PUISTIC	CLAY AS			n/ s.	Ľ	1 1-	1 [7		Citio	12m	3	CC	5	100	큠			33	ดี	តី		a I		֡ ֞֡֞֞֞֞֡֞֝֞֡֓֞֝֞֡֓֞֡֓֞֡֓֡֓֡֓֡֓֡֡֡֓֓֡֡֡֡֡֓֡֡֡֡֡֡֡֡	
1,10	AS			, A	,	0.5	१ १		AS.		60	COMPITIONS	5	Q C	<u>ش</u>	1240	코	NA		TYPE	CA C		[7	•	
				5	٦,	1 1	11		ASPHALT		٠, ۲		733	WATER COMMITTION	35	0	Î	M	8		3	7 0			
SPACE	ASOVE			2010	43M	4.5	Blow		٦		ع ع ع		0					٧.	400	MOBILE 			<u> </u>		
	61	**			- 11		, JO	·	7		٠,		DATE	Ħ	DATE	31VO	30	(SA	٤	֓֞֝֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֡֓֓֓֓֓֓֓֡֓֓֡֓	A C	LDGGED	-	BORING	SHEET
	. [5]				FINE		0 0		SMK		4						,	₹°	Ն	<u>,</u> , ;	2 0	COGGED BY:	3	Z	Ä
	-136				662		3		TA C		30		1/8		1/2	2/11		2A	9		֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓	? ?	ó	O	-
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<u>.</u>					Sor	î			CFACE													•			
		哺!!!	-		5	1	_																		

	FI	EL	D	<u>L(</u>	<u>)G</u>	0	F	<u>BC</u>	R	N(G (CONT'D.) SHFET 20F2
	SAMPLER TYPE		Ð	SAMPLE	LAB. No.	E NO.	USCAN M()	LITHOLOGIC	DEPTH (FEET)		PROJECT BORING NO. EAKER BX JOB NO. 3K98 TW1103
							200	120	//	1 1	
war sour	C1-21	5	5	Goas	E1103-3@1311	Hom 14'	10	+50 CV	14 15	1 1 1 1 1	CLAY AS ABOVE; BELOMES STIFFER AND MOTTUNE IS MURE APPARENT
CONTINUORS	Speir Spec.)	5 %	り	enenent_	w		2	ट्य	18 19 20 21		CLAY AS ABOVE; GREY BELOW 17' NO MOTTLING MOTTLED ZONE 19-ZO' CLAY IS SOFT AT BOTTOM 21-ZZ'
CONTINUOUS	SPUL SPOOD	5	5	Keelent	128 15/11/41	6 1322 E11-54-TW1103C	0 0 0 0	ડીઉ	2.3 2.4 2.5 2.6	11111111	CLAY; AS ASSUE TR SILT BLUE - GREY WINDSTLING; DX GREY BELOW 26
STRAIGHT	27-30	1	İ	1	1	1	1		28		TD =30'
		Ç			0	man (n. 1811). Santa (n. 1811). Santa (n. 1811).	<i>3</i> · · ·		2 3 4 5 6 7	y	
-	NOT	ES:									



	اساد			U	<u>Ol</u>			1 /1	10	
PLAI	V							11		PROJECT BORING NO.
			GRA	453				V	1	EAKER BX TW1104
	02	•		(a)	TN	o rec	1		j	JOB NO. 3K98 LOGGED BY: 15B
4w ¹¹									7]	PROJ. MGR. GV G EDITED BY: BFN
_@									\ <u>.</u>	DRILLING COMPANY: AW POOL
									(5	DRILL RIG TYPE: MUSSILE B-61
									17	DRILLING METHOD: HOLLOW-STEM AUGER
						7	Tw	μονι)	DRILLERS NAME: V. BARRAZA .
			_		,	-	•	ම ්		TOTAL DEPTH (FT.) 30
			211	3TL	01				1	TIME (12/11/91) 100 -58 (1439) V
L				•		}				COMPLETED 1500 DATE 12/1/5/
				₹.	FIGHT					GROUND-WATER CONDITION AT
					DE.			1		COMPLETION OF DRILLING SATURATED ZONG 18.5' and 1 19'
		و			183		ပ္			BACKFILLED. DATE (SEE COMPI
EB		ERED		Q Z	42	AN	0610	_		WEATHER CONDITIONS
로	ES-	⊢ŠI	료	ם	ᅙ	25	호	프		CLEAR, WARM 60°
SAN	발	RECOV	ACC CONTRACTOR	SAE	SA	至至		PE		SURFACE
			-	<u></u>				II	₩,	COMMENTS ASPITANT AT SURFACE
Auber 0-2		¥	,			١,		Ħ	5	Mar mar Hi ambuch
AWGER 3-2	2	1			1)		GC	Η'		FILL TO 2' GRAVERLY CLAY
0					1		G	Ħ	- ,	0-Z Fill
						0		11-2	-	
!! ! 		i	·					H_{-}		CLAY. DK BROWN - BROWN , VERY MO
					1			J	- ^	MEDISTIFF PLASTIC . TR SILT +
				Ì		5	,,,	П		Sp.
1 1			L				CH	1		2-8 CLAY
2-7'	ا	1	5	╽.	li	5	٦	H		
	り	り	3			•		H ⁵		
7			Excer	'				H		
) _			X		1	_ ا		He		
-		-	-							
3										
0				~ ×) 		- X-7-2			CLAY, BOOWN VERY MOIST MED.S
7		1	בעפונפאו	-	2	8	50/	He		PLASTIC: TR SILT + SD; MOTTLED
21-1			17	- h011 J	屋(5+4	H		GEENISH- GREY TO RUST COLUMED;
		. 1	1 111			\ L				INFERMINITERS IN VINIT - COUNTY -

ر ، بدعشت ساز

	FI	EL	D	L	<u> OG</u>	0	F	BC	R	IN	G (CONT'D.) SHEET 2 OF 2
	SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION		عا لــــا إن	HNUSCAN (PPM)	LITHOLOGIC	DEPTH (FEFT)	7 (PROJECT BORING NO. EAKER BX JOB NO. 3K98 TWILD4
							8		//		F.S - 1Z
tout to wour	21-21	5	5	Excernent	Į.		4 5	<u> </u>	13	-	CIAY AS ABOVE; SILTY CIAY WINE
Connucus	22-L1	5	5	EXCELLENT.	E 1104-2 (20)	6051 M	3 2	5 &	18 19 20 21		CLAY AS ABOVE: LT BROWN BELOW 18'; LATE SANDIER ZONE ZO - 21.5' SATURATED AT F 19'
		22 No	B 82.	36°	CAM	fram			23 24 25 26 27		
						n, moral	, ,	28 5	79 30 1 2 3 4		TD = 30
	TOP	Fe					=		9		



	化		<u>) </u>	0	G	<u>OF</u>	E		R = R	<u>NG</u>	SHEET 2 OF 2
Pl	_AN	1				- <u></u>					PROJECT BORING NO.
	_	<u></u>	<u> 424 </u>		<u></u> !	·	 715	<u> </u>	eb_	_	EAKER : BY SITE TWILDS
			. •	TWIKE	75 ·	٠ -					JOB NO. 3K98 LOGGED BY: BFN
-						1	Г	5	_		PROJ. MGR. GYG EDITED BY: JSA
				UZZ02	0	. į		A.L	ļ		DRILLING COMPANY: Pool
-	i	,	į	9	مُ الله	ì	. \	Sar		-]	DRILL RIG TYPE: mdile \$61
Î				, y	ال پر	1	1	÷			DRILLING METHOD: Hollarston Asiers
			- •	<u> </u>	- E.	1,	L			2	DRILLERS NAME: V. BAITELZA
1			•		`,						TOTAL DEPTH (FT.) 25
		-								İ	STARTED 0725 DATE 12/13/9/
1											TIME COMPLETED 0803 DATE 12/3/9/
=		ī		[:	—	>					GROUND-WATER CONDITION AT
1						ATORY Ber	•				COMPLETION OF DRILLING
					E E	E B		45			BACKFILLED. DATE
			ERED	Z	83	83	Z	000			TIME SEE COMPLETIONS
q		z	ভ	백원	5 ≝	24	<u>ಶ_</u>		ΞC	1	WEATHER CONDITIONS Cloudy, Coel & 42 0 7
Į		الخظ	RECOVE	날	72	증준	22	물병	급비		
6	3			88	E S	SAN	型	<u> </u>			SURFACE ELEVATION
-									U	3	COMMENTS Asphalt at source
		.	.						\prod_{\cdot}	- 0	0.0 to 0.2'
1		.]	1				Ì	Π'		F.II. Grovel clast mixed some
-				İ		Ì	ļ		Π		tines 0.2 toles
┝							· · · · ·		72	• •	
:	:	İ	l				1	SW	П	: ;	Fill: Sand . medium to tourse
i		Ì				1	1]3	1.	F. J. Sand Prediction & Conde
		İ	Ī				7.00	 	H.		Seried plants mait
- ;			Ì					ļ	H		non platice Stive Hadrococker Port
	7					•	1	1	Н		10 - 7.5
- 12	BARK				;	İ			H5	~ 、	
-1	/				5		750	7	Ц	· :	* Original soil
				Ì	3			İ	He		Sandy Clay Claver Fond: 300x15
	1//4	S	~				1	1			brown sandir fine erainer.
	r' 5p/17	5.0	ر بو	AIR	14	'		1	_		
	51 50/17	2:0	しで	FAIR	1/9		7-4-				to mart medium
	51 50/17	5:0	a. 7	FAIR	119		-	2.0			Sta slighty Natice
	51 Sp/17	5.0	ر ش	FAIR	13	2 2 2	744				Sta, slightly plastic.
	Acod 1 51 5011+	2:0	C &	FAIR	# TO THE REAL PROPERTY OF THE P		750				State slightly plastic.
	B. 30/17	2.0	Ċ	FAIR	2-2	2 - 10 - 120	750	SC			3+4, slistly plastic. 7:8 +4 13.0'
	417 BADON SI SPIT	5:0	6	FAIR	405.2		754		9		314, slightly plastic.

The state of the s

FIELD LOG OF BORING (CONT'D.) SHEET_Z OF Z PROJECT BORING NO. FEET RECOVERED SAMPLE CONDITION FIELD LAB. SAMPLE NO. EAKER SAMPLER TYPE JOB NO. 3498 EllTwo5 Sc saturated at 151 >540 3' 3017 SW FUR 6 >500 and spiral 17 to SC TD=25 NOTES:



FIE		וכ	0	G	OF	E	301	RII	NG	SHEETOF_2_
PLA	N=						į			PROJECT BORING NO.
				•						EAKER AFR EMPLOS JSB
							TW	(103		JOB NO. 3K98 LOGGED BY: BAN
					_	_ \	Ø		- 1	PROJ. MGR. GV G EDITED BY:
			,					_	٠	DRILLING COMPANY: POOL
]		(b)	1105		₩		DRILL RIG TYPE: MILL LE
	,						! '	3 -		DRILLING METHOD: Hellow for Account
			ഡ <u>ലാ</u>	م الا	1105		EUT	•		DRILLERS NAME: y Bulling
	<u>.</u>						ار	Ü		TOTAL DEPTH (FT.) 25
			GRAS	⑤ γ	onoi					TIME STARTED 0536 DATE 12/12/9/
							·			TIME DATE 1020 DATE
				E37	R N N				·	GROUND-WATER CONDITION AT COMPLETION OF DRILLING Sutvented at 16.5 unlat 9.0
			1	E B	A B					BACKFILLED. DATE
<u>ac</u>		ERED	공			Z	5			WEATHER CONDITIONS
LER.	ET VEN	<u>.</u>	頖	그의	끘	3 8	吕	EF		Partly ela.ly, lite breeze, cool
A P	FEET SEET		SAC	교통	X	至		E 등		SURFACE
Øi-	드리	<u>E</u> Œ	00	E &	E.S	I	133		200	SURFACE ELEVATION COMMENTS
1 '					!			H		
, 62 kg	0			,	,	,		H٠		Fill: Crave laired ultimes
2 6	Ň	0		1				Ц	-	Fill: Crave (nixed ultimes
<u> </u>								₂	EM.	
i							ML	Ц	1.7	Fill: 5:14 May dear stay maist
į						60	Ì	J		Sitt , w/ some small contreations
								H		0.3 to 3.5
14					1			∐.a		
13					İ	0		Ц		Silly Clay son thrown alsome
8						"	1.		1 -	Sand mist medicastill
1						1	***	Ш	-	alsone ende ander storth
1	0			١.			ML		-1	in Hed.
-["	K	۾ ا	3		1	-	1		11	3:5 to 2.0
" \p	4 7 -	- N	, v	د خانون د		50				
	<u> </u>	 	 		1			2		Tela Trlever Sand brown
ج ا		•		s weeks		-				to the same of the same
Same,			ŀ			0	SC	*		The company of the second
						"		Ή]	in 20000, June es Flat Grantes
3,74.7	6	0	1	1	,			Ha	K	710 to 10.0
13	h	5	1 %	ļ	'	10		H-	F	
1	l	1	ì	I	l	ľ	ı	\sqcup_{i0}	,	

,	FI	<u>EL</u>	<u>D</u>	<u>L(</u>	<u>)G</u>	0	F	<u>BC</u>	R	N	<u>G (CONT'D.)</u>	
	SAMPLER TYPE	FEET	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC	DEPTH FEET)		PROJECT GRUGE AFB JOB NO. 3K-96	BORING NO.
									H /	7 - 7 - 7 - 7 - 7 - 7 - 7 - 7 - 7 - 7 -		
<u>-</u>	1 2 Mar. 1	5.0	. 2. 6	i Guit	/	/	0	CL	3			stiff, miderate
	, <u>r</u>		•				0	sw	, , , , , , , , , , , , , , , , , , ,			from 12-16' dools
	5' 3011 pt	2.0	8.0	عهدمر	J	1	0 0	sw	20 21		Soul seam at	16.5' + 17' Nooth
		1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	7,000	Put 12.00	, c			리크	23 24 25	1. 21 5. 1. 1.		to brownish gray
	:							:	6		11. 5 to 2.	t et alay
									9 0		must sift to	exex sund comprises medium stite
			k. **			K. C.	ाम हुन्स १	Me _{nor}	3 4	MON 315		stith plaster
ię.	*		1,7				on and and	A STATE OF THE STA	6 7		TD: 55'	
	NOT	ES:	. +		···				10	-	The state of the s	



FIE		וכ	_0	G	OF	E	O	711	NG	SHEET 1 OF 2
PLA										PROJECT BORING NO.
								٦		EARCH AFR EITWO7
	_				2	thorn	'द्या	ا :		JOB NO. 3K98 LOGGED BY: UNE
) E	0 (1704)°°(••	.			PROJ. MGR. GNG EDITED BY: SFN
	-									DRILLING COMPANY: A.W. POOL
9) ,		\			J	ļ	DRILL RIG TYPE: 8-61
	T S L	<u>'</u>	' (TOU						DRILLING METHOD: House Sten Augen
3	1 K			SCAL	7	0				DRILLERS NAME: VINCE BARKAZZO
Antein	3)		ľ	,	}			TOTAL DEPTH (FT.) 30'
4	1				!		,			STARTED 1515 DATE 12/13/94
										COMPLETED 1600 DATE 12/13/91
i	1			¥~	EB Z					GROUND-WATER CONDITION AT
1.				AEC DE	PEG					parrel sufficiented of 200
		읎				_	<u>ي</u>			BACKFILLED, DATE
E.	2		삗	Z	34	CA	21907	 _		WEATHER CONDITIONS
풀빈	ᄪ	ES	到	35	SANP	EMAL)	울	PT	Ċ	PARTY CLOUPY SAPE MAND 55°F
SAN	FEET DRIVEN	뿐	80	SA	SA	¥£	CODE		. ; :	SURFACE ELEVATION
1		İ						_	※	COMMENTS
1,-								⅃,	 - : -	ASPHALT @ SUNFACE
I A	2.0	-	-	-	-			Δ΄	ن تا	0-3:5, Asphalt + Fill
									FM	
1	!					7500			- ;_	• .
;	İ] 3		
ابا							ļ		- 1-	3.5-6.5' CLAYEY SAND + SANDY CLAY
3				- (SW.		- :=	AUTERNATINE, SAND -CEARGE STE
DARGEL			3	70	;	K 500	150			GRAINED : CLAY - MODERATELY
	5.0	3.5	EXCELLEN	E11Tw07	_			5		SUPE, DAME BROWN.
15		}	3					M	- 14	Moist
Speit			الخرا	Ū					<u></u> -	
- _			"			7500	\ \ ! <u>4.1</u>	.		6.5-10.5. CLAYEY SAND YREY.
		-		7 .			1			Sive grained mois to
					-	5000	Sc		[: <i>;</i> :	wet.
		1	CEMENT	- সেই	,	• تعددوت آبد	- W	10		
	5		1 3		_					
SPile	\$ 5.0	5.0	7	-		7500		9		
ام د	<u> </u>		¥ س	1		1200		N -		
1	1	1		1	1	ı	1	1731	1 . :	'

FI	EL	.D	L(G	0	F	BC	R	IN	G (CONT'D.) SHEET -OF -
SAMPLER		Ð	SAMPLE	LD LAB. PLE NO.		T	LITHOLOGIC CODE	Ţ		PROJECT BORING NO. EAKER AFR EITWIO7 FITUO7 JAC
	SCC	PKE	٧. ا	٨٠٠		poo	CL	11		10.5-21.0; Brown-Grey Cray, hard, plastic, mottled
STUL	0.0	5.0	Excellent	-		9000 95000	PC#	{3 4 5 6		
SPUP BAPAGE	5.0	0.0	FXCELLENT	E11-TWD7-02		1500 7500		_	11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	21.0-22.0; SANDY CLAY, Soft, brown, saturated.
F	5.5		,	-	-			23 24 25 26		BETTHEEN 22-30 - COANTE TAND
181	3.0		{	\ \	1			-27 -28 -29 -30		ALTERNATING WI MOD HARD, DATHE GREY CLAY, MOSTEY CLAY HORIZONS.
					7 .		<i>9</i> /	2 3 4 5	g et e	
NOT	# 200 A 10	2 8/4						9		

NOTES:



F	ΪE	1_[) l	٥	G	OF	: B	O	RII	VG	SHEET OF
PI	A	1		· · · · · · · · · · · · · · · · · · ·		Short	EME		Pum	- -	PROJECT BORING NO. ENTER AFB ENTER SPE
				C.	m	ر ۾					JOS NO. 31-98 LOGGED BY: URE PROJ. MGR. G-VG- EDITED BY: BFN
		,		EI	,	0			Pum	ле 5	DRILLING COMPANY: A.W. POOL
H											DRILL RIG TYPE: B-84 6/
	3										DRILLING METHOD: HOLOU STEM AUGERS
	SP IA								Pur	ş	DRILLERS NAME: VINCE BARRAZZO
	1									-	TOTAL DEPTH (FT.) 29
\											TIME -0645 ALL DATE 12/14/91 TIME -0645 DATE 12/14/91
<u>_</u>	Ī	Ī		1	-	>				ŀ	COMPLETED ONDS CONTINUE CONTINUE AT
	İ				55	FIGHT					COMPLETION OF DRILLING + + 10'ani/ 21'
			اه		A B	AB		ပ			BACKFILLED, 12 1/20 DATE 12-18-9/
g	5		ERED	교질	A E	E BE	NA	000	_		WEATHER CONDITIONS
		E.	⊦Š	렿	ᅙ		E SC	ᅙᇳ	E III		PARTLY CLONDY, MID 403, 10 MPH WIND
	Z N	EE!		80	ES.	SA	至	18	35		SURFACE ELEVATION
	1								Ц	怒	COMMENTS
		0	·	,	•	1	,		Ц,	ļ	ASPITALT @ SURFACE
-	Bit	d	١,					 	Ц		
		}						_	2	0	FILL 0-6.5', SAND, WELL SOLVED.
ļ	;								H	1, 1	MED. TO COAME GRAINED
i			,						3	0,	
Ì	Eca					_		SW	H	' ,	
I	BARRELE]	186		1	H	j '0	
Í	βA	0	iΑ			SellogA	500	 			
	レイ	5.0	25	Good	1	1 1		İ	5		
1	とりて			B		35			W.		-
	•					Ī	-i 50e				-
- 15] .×	* * * * * *			1				Moy CLAY Brown -1
							500) <u> </u>			Great portes, Moist, Horo concon
-	ل ا			Ş				SC	10		CISOT BEWART SANOTER - L'DECOL
	3	2	0	3						-	
	SAREL BARREL	S,	S	Freside	֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓	1	7500	2	9	-	
-	192	1		1	1		.		#-		

	FII	EL	D	L()G	0	F	BC	R	IN	G (CONT'D.) SHEET 3 OF 2
	SAMPLER TYPE	FEET DRIVEN	RED		FIELD LAB. SAMPLE NO.		J	CODE LITHOLOGIC	DEPTH (FEET)		PROJECT EAKEN JOB NO. 3K98 EH SEUTE EITWILES
	·						ISO	5 W			10-11' SAND : MEDIUM GRAINED, WET, APPEAR & TO CENTAIN FREE PRODUCT
	Spire	5.0	8.0	FXCELLENC		Fil -54-581108B	*5000 is a	CH CH	12 13 14 15 16 7		11'-Di' CLAY, brown of grey mattles, hard, plastic
	SPLAT BARAGE L	S .O	5.0	Excenent	ţ	E11 - 34- 581 106 C	0 % 0	CL	18 19 20 21	1 1 1	21-TO CLAY grey hard, plastic, WET @ 21.
- 1	H-12	8.0	1	_	1	•	1		- 23 - 24 - 25 - 26 - 27	1	SOME SAND ZONES PROBABLE BASED ON DRILLERS COMMENTS.
-	12.00	ئ ن	_		1	١	1		28	11.11	
¥.			 	Î.			N-1		0 1 2 3 4 5 6 7		

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PLA	N									PROJECT BORING NO.
	-		1	:	3 lb 6	PET	25		•	EAKER AFB EITWILD9
			į			•••	1		-	JOB NO. 3K98 LOGGED BY: URE
			1	ا			γ			PROJ. MGR. GUG EDITED BY: B FM
				Dat			1			DRILLING COMPANY: A.W POOL
٠ ـــ		168 G	,	(8)	PENS	٥,٤٠٥		Ent	w1100	DRILL RIG TYPE: 8-8-12-61
(-11	וושדו	100 C	,				' '			DRILLING METHOD: House soon Angen
			٠				1			DRILLERS NAME: V. BARRA 220.
										TOTAL DEPTH (FT.) る5
										TIME 0925 DATE 12/14/91
				•						COMPLETED 0955 DATE 12/14/11
·					FR					GROUND-WATER CONDITION AT COMPLETION OF DRILLING Substantial at 1 10 and \$ 21.5
		9			용물		ပ			BACKFILLED, DATE
ER	-	ERED				NA	01907		. 1	WEATHER CONDITIONS
로	VEN	1.8	런	르	岛) E	로쓰	E H		CLEAR, LAPER 30: , 10 MEH WIND
SA	FE	THE COLUMN	38	SE	SA	E				SURFACE
									쌼	()
		•						∐ , □	• •	Asphalt & Surface
811	2.0	-	-	7	•			Ц	FM	
								12	. '	0-4.5 Fil, MOSTLY MEDIUM
				_			5√	H	.	GANINEO SANO, WELL SOMED
								-		
					•		Ì	71		
					0	3000	1	H	-	4.5-6.0' CLAY DARK BROWNISH GREY
			2		=			K		MODERATELY SOFT, SUGALTLY PLAST
S.B.	5.0	3.5	Goon	-	Su-Twiloga	2500	CH	5		TRANSITION INTO LOWER BROWN CO
			۵		30					SANDY
.					-119				= =	6.0- 9.5' CLAY REDONN BROWN,
÷ .		,	.	,	LU		<u> </u>			GREY MOTTLES SOME LILT.
-	-	 	-		24		- JC		-	
		::. <i>,</i>	-		_		-	-		
			_		-TEN1109	500				
C E	5.0	4.0	800	-				H.	1.7	9.5-10.5' SAND FINE GRAINED GREY
D. 5		"	10		75-				·	WET FREE PRODUCT APPEARS TO
			t		1	750		- 10 T	7.	-1

FI	EL	D	L) <u>G</u>	0	F	BC	R	N	G (CONT'D.) SHEET -OF -
SAMPLER	-	OVERED	SAMPLE	LD LAB. PLE NO.	FIXED LAB.	AN	LITHOLOGIC	DEPTH (FEET)		PROJECT BORING NO. EAKER JOB NO. 3K98 EII TW1109
						50 c	,	1,1	- 1	MODERATELY PLASTIC ABUNDANT FEEQ
S.B.	5.0	5.0	ERCEUENT	•		18 3e	CH	12 13 14 15 16 7	i – i	CONCRETIONS, MINER SILT, MOIST. -TRANSITION INTO COLOR LINIT 15-19.5 CLAY, GREY MODERATELY PLASTIC. MINER SILT; DAME. SUFFEE MOIST
S.B	5.0	5.0	CACELLENT	1	E1-Su-Tuloge	0		18921	111111	19.5-25? SILTY CLAY, GREYNISOME LT. BRW LAMINAE, SCFT. WATER NOTEO @~ 21.5
BIT	1	1	•	1	-	_		3 3 3 3	11111	TD = 25'
					•		i de la companya de la companya de la companya de la companya de la companya de la companya de la companya de	6 7 8 9 0 1 2 3 4 5 6 7	i sgr. tirk	
- 1				Ě		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		9,		

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PLA				<u> </u>	<u>OF</u>			711		IPROJECT BORING NO.
ГЦА	N.	I		S	Hope	PETT	E			EIITWIIIO
										JOB NO. 3 K9 8 LOGGED BY: URE
										
		;		bem.		0 [EIIT	wic	>	DRILLING COMPANY: A.W POOL
		ĺ	۸.,	200	,7)	٠				DRILL RIG TYPE: B-61
				PENSE		€	Elito	٥٥٩		DRILLING METHOD: House STEM AUGER
		`								DRILLERS NAME: V. BARRAZZA.
			VAC	.wecs	-\					TOTAL DEPTH (FT.) 25
					== <u>.</u> '					TIME 1322 DATE 2/14/91
										COMPLETED 135.5 DATE 12/14/91
				ATORY BER	ORY R			-		GROUND-WATER CONDITION AT COMPLETION OF DRILLING SATURITED I 8.5'
		۵		BORA	A B		ပ			BACKFILLED, DATE
SAMPLER TYPE		8	NO NO	医医	A Z	AN	000			WEATHER CONDITIONS
로	EN CEN	⊢Š	ᇙ	걸	드로	28C	13	E T		CLEAR, MID 405, 10 HPH WIND
SAN	PER	REC	800	SE	SES	至	750 740 740	HE HE		SURFACE ELEVATION
									1 01	COMMENTS
		•						\Box	10	ASPHALT & SURFACE
BIT	2.0	-	-	-	-	_		Ц	oth	
			<u> </u>				1	2	11	0-25 Fu (Not RECURATED)
					-		ادر	 	-	
i				ľ	87	100	اعد	3	- 5	2.5-4.5, SANOY CLAN DAPLE BROWN,
					*					ORBANIC PLCIF
	Ì				=			-	5,	- TRANSITURI W/ LOWER LINIT
S.B	5.0	4.5			120110	>500	*			4.5 - 8.5' SANDY CLAY TO CLAYET'SAND
			6	3 1	- (5	<u> -</u>	Brown Money motries, MOD. SOFT
			5		1 2				-	DAMP.
					1 =	7500	,			
			:					I,		
					(d)					
-				A face of the second	9			8	1.5.	
c.	5.6	ء د اد		1	-54-TW1110	30-			Į.V	6.5.05
b.p	17.	۶۰۶ <u>۶</u>			15			9		8.5-9.5 8.59578 CLAYEY SAND BROWN W/
1	l l									

FIE	EL	D	L() <u>G</u>	0	F	<u> BO</u>	R	IN	G (CONT'D.) SHEET ZOF Z
SAMPLER	FEET DRIVEN	FEET RECOVERED	SAMPLE	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC	DEPTH (FFFT)		PROJECT EAKER AFB JOB NO. 3K98 EII TWILLO
								1,	-	85'95' CONTINUED) WEE IN SAND " ZONG. 95'-13' CLAY HAND, PLASTIC, BROWN
S.B	S. 5	5.0	Geenenr	(•	0	CH	12 13 14 15 16 17		MGGEY MOTTLES MINOR SILT, FE STEIN and podules. DAMP. -TRANSITION ZONE W GREY CLAY BELOW 13-22 CLAY GREY HAND PLASTIC, SOME RED STAINS, MINOR SILT
S.&	5.c	5.0	EXCELLENT		1	0		16 15 15 14 14 16	- - - - - -	22-25' BIT (NO PECOVERS)
BIT		-	_	_	-	_		7: -4	- - -	
	97							f	9	To -25'
TON	 Tes:	· · · · · ·	 	 	+	-		, ∙ ∐.	- او	



FI	ELI	וכ	LO	G	OF	E	10	RII	NG	SHEET 1 OF 2
PLA					N					PROJECT BORING NO. EAKER AFB EII TWILL
										JOB NO. 3K98 LOGGED BY: BFM
										PROJ. MGR. GVG EDITED BY: BFN MIL
	1 2 kg	, t		4	7			1		DRILLING COMPANY: Pool
	42.0		CAN ^{O†}	1					3	DRILL RIG TYPE: Mobile , 861
		1			_				K	DRILLING METHOD: 644 Hollen Sten Auers
11,	ر کیلے		CIPL		ā)	ı		į	(کی	DRILLERS NAME: V. Burrazzu
	. ن اند	<i>ـــري</i> ـ	1	\$ TUNE	,•				L "	TOTAL DEPTH (FT.) 22/
16	Turil									STARTED 6753 12.15.9/
		_								COMPLETED 08/0
ĺ				ATORY Ber	ITORY ER					GROUND-WATER CONDITION AT COMPLETION OF DRILLING Entrafol of x 110 and at 2211
		٥		3 = 3			2			BACKFILLED, DATE
EB	FEET DRIVEN	E 2	NO NO	E N		NA.	000			WEATHER CONDITIONS Clour, cold, listbreaze & 30"F
ᅙ		μŠ	호	عَمَ		E SC	2 11	E		E 18007 1010 7 11311 441
SAN	RE	REC	SO	ES	FIXED	至	100			SURFACE
									400	COMMENTS
		•	1	١,	,		ļ		500	Asphall at surface 0.0-03
301.0	2	0	'	۱ ۱	')		Π′	1	
9.5	2							ַת ב		Fill; acres mixed of sines
									100	0.3.1.0'
							. وسا	H 3		
Ìу	, }	 		1			2M			Fill: Sand bonne la staybears
4				ł		7500	4			medium to course rained loase
18							7/0	<u> </u>		1.0 40 7.0
1,							3			
13				1	1,	7500	d 3	Ц	1:	
100	5	,	3	ì	1		7500	4		clay , brown, with silt and
6		, ,	00	1				H.	1.	trace us. sand moist, soft
	<i>•</i>	•						Ħ,	4.	to medium stiff To
T,	,								1	
· · · · · (v	1			 	765		18	15.	Subtrated zone XIII
1	2						اعو	11	1-	Sundy zone ul clay mover
١	: -			11/1		767	c d .	و	-	incist to net, soll
	4 6	6	1 3	1				H_{-}	<u>-</u> -	10 40 11:0'
_ }	~		10	ن ا ن	l	60	رر	\sqcup_{n}	。	
Softe 1	**.						~^			a national designation of the second

	FII	EL	D.	L)G	0	F	B0	RI	N	G (CONT'	D.) SHEET SOF 3
	SAMPLER TYPE	2	OVERED	SAMPLE	FIELD LAB. SAMPLE NO.	ED LAB.	IUSCAN PM)	L/THOLOGIC CODE	DEPTH (FEET)		PROJECT EAREL AFB JOB NO. 3198	BORING NO.
									1	7.1	6.11	
č	S. SPLIT	ک,	4	8000	1	1	600 600	CL	3 4 5 6	コンナファ	ense II	comp, who was send
	541121	۶,	٠ ح	مجده در مر		1	600 0	CH	8 9 20	111111111		ency, moist, very still ame self present, mothed
									3 4 5 6 7 8 9 0 1			
				×			ACV :		3 4 5 6 7			
	* ************************************	-	<u>.</u>				7		9	i ii iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii		
,	TON	ES:			1 - 	1	1		u ō	, ,	1	



44	احياد	J		G	-			700	<u> 10</u>	SHEET OF _Z_
ΔΙ							,	· · · · · ·		PROJECT BORING NO.
	·									EAKER AFR EITWIIZ
ſ		_								JOB NO. 3 KSB LOGGED BY: BEN
1	þ	1							H	PROJ. MGR. GV G EDITED BY: VSB
١,	, E	C	MOP	V = 25	7				·	DRILLING COMPANY: Pool
			م حالم المحاوى]					DRILL RIG TYPE: MOSILE, BEI
			·	b.cwH	12					DRILLING METHOD: 6 4 Hollow sten focus
	\Box	<u>—</u> [216				\Rightarrow			DRILLERS NAME: V. Barro 220
	(A)(II)	•			•					TOTAL DEPTH (FT.) 25
4	Ame.								İ	TIME DATE 12-15-91
										TIME COMPLETED 1030 DATE
=	j	<u> </u>	1>	- 1	·	1				GROUND-WATER CONDITION AT
			5	56	<u> </u>	ļ			ŀ	COMPLETION OF DRILLING
ł	i			E			.			BACKFILLED, 13:-10 DATE 12-18-9/
		ERED	्रहा		불리	3	2150			WEATHER CONDITIONS
֭֭֭֭֭֓֞֝֞֝֓֞֜֜֜֓֓֓֓֓֓֓֓֓֓֓֓֡֜֜֜֓֓֓֓֓֓֓֡֓֜֡֓֓֡֓֡֓֡֓֡	드립	الخ			끊	0 0	ğ.,,	E)		clear, cold, list breeze 23007
5	FEET DRIVEN			SAL	SAME	E PER SC	CODE		4.0	SURFACE
<u> </u>	40	re:	<u> </u>	<u> </u>	L (S)	I = 1	70		×××	COMMENTS
								'	-00-	,
1	Ì	.				,		4	00	Asphalt at surface 0-0-0.3
817	2	0	1		- 1			\dashv		
,								2	FM	Fill: Gravel clost missed ulfines
	, ,				•	1 t				ll
								H	-	0.3-1.0
								- 3		
						75°°°		3		Sandy alay, gray I some s'H
.1						75 ⁸⁶		3		Sandy alay, gray loone sitt maist, soft, tous excesses
707						75 ⁸⁶ 6		3		Sandy alay, gray I some s'H
ULKO Z						7586°	CL	3		Sandy alay, gray some sitt maist, soft, touch excepts
ì			م	1		7500°	2 C	3		Sandy alay, gray Isone s'H maist, soft, touch ercasies (rout hours) possible fill
LIT BALKOZ	٤,		ה נו כת	1	1	7500°	Cr Sc	3		Sandy alay, gray leane 3'H maist, soft, touc ercenics (rout hours) possible fill
SPLIT BALLECT	5,	,/5	8000	1	1	7500°	Cr Sc	3		Sandy alay, gray I some 3'H maist, soft, touc ercasics (rout hours) possible fill
``	٤/	<i>//</i> 2	8 0 ucr	1	1	750°.	Cr Sc	3		Sandy (lay , gray Isone 3'H maist soft tous erearies (rout hours) possible fill strong hydrocarbon adam. Sand soom x 8' 1085', saturated
``	٤,	//-	8000	1		7508°	CL Sc	3		Sandy clay, gray I some 3'H maist, soft, tous ereasies (rout hours) possible fill strong hydrocarbon adam.
5' 51117	3,	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	800cl		1	7500°	CL SC	3 4 5		Sandy (lay, gray I some 3'H maist, soft, touch excesses (rout brancs) possible fill strong hydrocachun adar. Sand soam x 8' 1085', subruh
5' 57117	5,	``	800cr	1	1	7508	CL SC	5 6		Sandy Clay, gray 1 some 3'H maist soft tous ereasies (rout hours) possible fill stroy hydreacher ador. Sand seam x 8' 108.5', submbe sund scam x 10 1010.5' submbe
``	٤,		6000			7500 15500	5	3 4 5		Sandy Clay, gray 1 some 3'H maist, soft tous eresies (rost boxies) possible fill strong hydreacher ador. Sand soom x 8' 108.5', submble Sund Scam 2 10 to 10.5' Sutural
5' 51117	5,		60c' 500c'			7508	5	3 4 5		Sandy clay, gray I some 3'H maist, soft tous ereanies (rout hours) possible fill stroy hydrocarbon ador. Sand seam x 8' 108.5', submb sund scam x 10 1010.5' Eutomed

FI	EL	D	L)G	0	F	BC	R	IN	G (CONT'D.) SHEET ZOF Z
SAMPLER		92	SAMPLE	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO	HNUSCAN (PPM)	THOLOGIC ODE	DEPTH (FEET)	ŕ	PROJECT EAKEL AFB JOB NO. 3K98 EIITUII IZ
						75°80		-"	1 1	
5' 5PLIT 69202	4	4	Euow.	1	1	; 0 0	C.H.	12 13 14 15	11,11,11,1	Clay brownish stay, elichthy mattled, maist medicastiff Some silt brose of sont, plostic 10.5-15.0
5' SPLIT GAREET S	12	6	pros	1	1	0	ડા ઉ	- 18 - 19 - 20 - 21	4,1,1,1,1	Clay blue gray, most, stiff
1:18	110	ile of	gat Sit	r 15	•		,	22 23 24 25		Saturated 2010 st \$21'
								6 7 8 9		TD:25'
							، تير	0 / 2 3 4 5 6		
NOT	ES:		···· , ·				,	8 9 0	•	



F	TE) l	0	G	OF	- B	0	RII	NG	SHEET LOF 2
۶	LAI	v =			3⊁ SPPET						PROJECT BORING NO.
				SH	opvet		1401×3				FAKER AFR EITWIII3
1	7			<u> </u>							JOB NO. 3K98 LOGGED BY: LRE
- 1	다. 151										PROJ. MGR. GUG EDITED BY: BFN
	6 9		<u>.</u>		- A-E	DIAN			-7		DRILLING COMPANY: AW POOL
	U ,	1						11 TW	7		DRILL RIG TYPE: 8-6
	ı					a a P	AMEIN	_	_ ,	4	DRILLING METHOD: HOLLOWSTEN AUGEN
	Ì					EII TV		1	-		DRILLERS NAME: U. BAYLLAZZA.
	(Sras.	\$,	*/\	~70′	4	¥	4	İ	TOTAL DEPTH (FT.) 27
١	1	•					EIIT	~111	3	√ ∦	TIME 1350 DATE 12/15/91
L	1	,	+					4			TIME COMPLETED 1445 DATE 12/15/91
i					₩ E	ORY R					GROUND-WATER CONDITION AT COMPLETION OF DRILLING SALVACE SAND ALS NO LANDS &
	ŀ	ļ	İ	ľ		AB					
1	.	Ì	뭐	z			z) 			BACKFILLED, 0739 DATE 12-18-9/
	E	Z	ÆRED	백입	₹ ₩	ZH	ৰূ	٥	±C		WEATHER CONDITIONS
	들빈		ES	到	FELD SAMP			물병	딘		CHEAR SMPH WIND, MIDYOS
	<u> 38</u>	ER		88	SAS	SAN	至				SURFACE
	.			i			1		Ц		COMMENTS
ı	٠,	0	_ ;	۱ ،		,	,		Ц,		GRASS @ SURFACE
	1	6	1	· I	1	Ì		ML		24	
	B								H 2		
ļ		!					b	5W		.	0'-3' PLOW ZONE + POSSIBLY FILL.
	į								3		2-3 MED. TO COARGE BUNINED
•	١		,			ļ				16.	SAND, DAMP, Some BLACK CACANICI
	BANGEL							CL		-	AND RED TRON CONCRETIONS
	\$	اما	0		١.		1			<u>۔</u> ا	3-4.5' SILTY CLAY, D'ARL BROWN
	5	5.0	้หั	0		/	٥		5	1	VERY MOIST, SOFT, MOD. PLASTIC
	ط ا		"	Good							4.5 - 10' SILTY SANDY CLAY, LT BROWN
	Stug		1					ļ			W/ RED + GREY MOTTLES.
	0						0			=-	BECOMES LIGHTER IN COLOR WOEPTH,
•		<u> </u>		-		_	• • • • • •			:=:	MORE GREY WI DEPTH.
	ا ا								I	-;	ZONES HAVE WATER IN 8-10 DA
	12	-	,			1	0		T.	:= <u> </u> :	SANDY DUTENIALS ASSE TO BE THINK.
	BARREL	0	0	-	1	1					
	2	V	N	Boack	1	1		Cı		:	
	SPAF			ã			1	MI	#_	:-	
	1 5			1		1	ľ	1	₹1.	.] :	

FII	EL	D	LC)G	0	F	B 0	RI	NO	G (CONT'D.) SHEET 2 OF 2
SAMPLER	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. Sample no.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC	DEPTH (FEET)		PROJECT BORING NO. BAKER AFB JOB NO. 3K98 EILTWILL3
	rne	<i>و</i> ا ن		PAC		0		1.	1 1 1	10'- 21' CLAY, LT BROWN TO GREY. SILTY: RED IMM STAINS 12'-21'.
S.B.	5.0	5.0	CACELLENT	1		0	CH	12 13 14 15 16	1 1 1 1 1	- BECOMES GREYER + LESS SILTY IN 12-19.5 DITEMAL, PLASTIC, HARD - 19.5 - 21', BECOMES LT BROWNIGH
S.B	5.0	5.0	EKCEUENT	E1113-01 @as'	ţ	0 2 7	_	17 18 19 30 2-1	וווו	RED, LESS PLASTIC, MONE SILTY THAN ASONE 21-27 SAND, COASSE GRAINED, MOD. WELL SORTED, WET.
				III			SV	25 26 27 8		22'-27 is some (as per driller connects) TD =2-7'
								3 4	steen s	
NOT	TES:							8 9		

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IE	<u>L</u> [) L	_0	<u>G</u>	<u> </u>	<u> </u>	<u>UI</u>	<u> </u>	<u> </u>	
AN										PROJECT BORING NO.
h	⊦ -1 -1	T-7-3				-(T			EARGH AFB EII TWIII4
- (1 1	e e i ! I s	اهر	E	111	V 1		<u></u>	JOBNO. 3K98 LOGGED BY: URE	
					ري				PROJ. MGR. GVG EDITED BY: BFN	
	G	DEI	TW	illy				LO T	DRILLING COMPANY: A.W POOL	
	•		•	·		_ @	EUT	ماررز	DRILL RIG TYPE: 8-61	
G	_ም ለዓ	55				`				DRILLING METHOD: HOLLOW STEM ALGER
	FEL				1.					DRILLERS NAME: V. BARMAZA
					-					TOTAL DEPTH (FT.) 24'
						•.]				STARTED 6955 DATE 12/16/91
										COMPLETED 1105 DATE 12/16/91
				≿~.	Α.					GROUND-WATER CONDITION AT COMPLETION OF DRILLING Suspended Zone of to and t 21
			l	RATOR) MBER	RATORY					
-	1	ᇜ	2		S S	7	ည္က		'	BACKFILLED, DATE
ן נ	z	FEET RECOVERED	SAMPLE CONDITION	Şщ	اس	SCAN	HOLOGIC	EC		WEATHER CONDITIONS
TYPE	FEET DRIVEN	무잉	至	FIELD	FIXED		욷띯	DEPTH (FEET)		CLEAR, MID 305, 5 MPH WIND
₹		[[]	80	SA	문장	NE NE	H 8	195		SURFACE ELEVATION
		Ì				 	Ì	Ц		COMMENTS
-	ا ۔	. [Ц,		GRASS & SURFACE
it :	۵.٥	_	_	•	-	-		Ц		0-4' No necessary
								2		
				ļ				Н		
1								H3		
								H		
										4.8-S.O SAND, MED GLAINED, MOIST.
						0	SW			HED COMINDO POLISI
S.B.	5.0	3.0	3000	.		C		5	-	5-6 Sivry CLAY DARK BROWN, MOD.
			ජ		/	"	CL		-	SOFT, SUGATON PLASTIC MOIST.
							CH	6	-	CNAS NOWIN
*	- 2-1	1				v		1 -	•	6-13" SANDY SILTY CLAY BOWN
		 						7		of BERY MOTTLES. SUGATING
. FA .							Cit		-	PLASTIC, MISH TROW STAPPUS
			١				"	8	-	12'-13'.
			12.33	I	11				-	WET ZONE 8'-10' IN MORE
5.8	5.0	4.5	2		'	0		9	-	SANOT BOYER DITERVALL
l		1	.¥	<u>:</u>		1	1		-	-

<u>F1</u>	<u>EL</u>	<u>.D</u>	<u>L(</u>	<u>)G</u>	0	F	<u>BC</u>	RI	N(G (CONT'D.) SHEET 3 OF 2
SAMPLER TYPE	FEET DRIVEN	9	IPLE DITION	CE NO.	1	HNUSCAN (PPM)	010610			PROJECT EAKER AFR JOB NO. 3K98 EII TWILLY
s. ß			ı€U	PAG	E	O	,	1/		-TRANSITION WILDHER GREY UNTIE 13'
s.B	5.0	5.0	ERCECLENT	•		0	C T	13 14 15 16	1 1 1 1 1	13-21' CLAY, GREY, HARD, PLAITIC, PEO TRONSTAINS 13'-16'. -BECOMES HARDER + MORE PLAITIC W DEPTH.
S.B.	5.0		EKCEUENT	E1114-1	•	0	SW	18 19 20 31	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	21-24 SAND, COARSE GRAINED; WET.
Bit	2.0	1	ı	-		-		3 4 5		MOO. WELL SORRED WET @ ~ 24' TD = 2-4
	·							8 9		
				·				2 3		
						v		5 6 7		
NOT	ES:	*						8 9	-	
-		~ M	s pe	~ ധ്ന	(less	ارت	ment	.4		

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THINK IS



COFFCFATEN											
FIELD LOG OF BORII		SHEET 1 OF 2									
PLAN	PROJECT	BORING NO.									
G	NE EAKER AFB	Entwins									
(a)	JOB NO. 31498	LOGGED BY: JUL									
" Bx	PROJ. MGR. QUG	EDITED BY: BFN									
Sitores	DRILLING COMPANY	: A.W POC									
Elituni3	DRILL RIG TYPE:	B-61									
Ganes	DRILLING METHOD:	Howen SAM AUGEN									
EUTWUS	DRILLERS NAME:										
•	TOTAL DEPTH (FT.										
) C	TIME 1370	DATE 12/16/91									
THEO STREET	COMPLETED 142-C	DATE 12/16/91									
	CONTRACTOR CONTRACTOR	TION AT ING I Zones at ± 7 and 17'									
MATOR SER SER SER SER SER SER SER SER SER SE	Saturates	Zones at - / Zones									
	BACKFILLED, TIME	DATE									
CAN ABOUN ES	WEATHER CONDITIONS										
- 독파- <u></u>	CLEAR, MID to	UPPER 4CJ, WOYTWIND									
TELL PERSONAL PROPERTY AND THE PROPERTY	SURFACE										
	COMMENTS										
	GRAN & SURFA	.ce									
BIT 2:0	0-2 NO RECEIVE										
1 1 1 1 1 1 1											
o cul	2-3' CLAY,	DAME BROWN ORGANIC									
		BUVOANT ROOT HAIRS MOIST									
	- 3-9' CLAYE	SMOY SILT SILTY SANDY									
ML CL	1	BROWN , SILTY ZONES - MONTE									
		RE FINABLE THAN CLAYED ZONES.									
SB 5.0 5.0 4	- ROOT HA	URS + DROMMES & TOP . MOIST									
S.B. S.O 5.0 3 3											
- 4 0 6											
	- WET ZON	E ~7' WHERE MORE SAL									
	- Int PRESI	5WT 2									
77 88											
SB 5.0 50 3 7 0 C. 1											
S.B. 5.0 50 33 1 0 CL CH	- 9-19' CLAY.	BROWNISH GREY W RED									
	الراب المستند	F. HARD PLASTIC . MINOR SD + SILT.									
	7·	and the second s									

LOG OF BORING (CONT'D.) SHEET 2 OF 2 PROJECT BORING NO. FIELD LAB. SAMPLE NO. LTTHOLOGIC CODE DEPTH (FEET) EAKER AFR SAMPLER TYPE FEET DRIVEN JOB NO. 3 498 FIXED LA SAMPLE HNUSCAN (PPM) EIITWIIIS MO15T 9-PAGE SEE PHEU. 11-12 - Drow STAIRS O 5.8, 5.0 50 0 0 و <u>ء</u> و آ 0 CLAYEY SAND, LAMINATED, SANDENE GH d S٢ 19.5°. 5.0 5.0 S.B. 20 0 Ems MOIST TO WET UP TO 17 . GREYISH BROW 2/ Y TO = 22'

NOTES:



FIE	ELI	DI	LO	G	OF	: B	O	<u> </u>	NG	SHEET L OF 2
PLA					1	1				PROJECT BORING NO.
}	S Hor	PETE	<u>.</u>							EAKER AFB EITWILL
	7 1000	 [1	JOB NO. 3K-98 LOGGED BY: JAL
	•	ر ادم	えんぴろ		1.		En	Twil	ا د ا	PROJ. MGR. GUG EDITED BY: BFN
		1	הו		15		•			DRILLING COMPANY: A.W. POOL
	<u> </u>	1 Trigi			9					DRILL RIG TYPE: 8-61
	3									DRILLING METHOD: 1000 - SPEIN AUGEN
					1					DRILLERS NAME: V. BARRAZA
				•					İ	TOTAL DEPTH (FT.)
				÷	- 1	\	\			STARTED 1530 DATE 12/16/91
						<u></u>	<u>_</u>			COMPLETED 14 2-8/600 DATE 12/16/91
				RY *	RY		,			GROUND-WATER CONDITION AT COMPLETION OF DRILLING
				RATOF MBER	ATO BER					COMPLETION OF DRILLING SATULATED 2016 \$ 10 and 17,115
		ED	_	ABORATOR) : NUMBER	ABORATORY NUMBER	_	3IC			BACKFILLED, DATE
ER	Z	ERI	백혼	EA	A P	CAN	9	+ .		WEATHER CONDITIONS
SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LA Sample	FIXED	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)		CLEAR MID 505, UGHT WIND
AS L	FR	끮	88	RAS	E&	<u>₹</u> 0	58	9	<u> </u>	SURFACE ELEVATION
								Ц	}	COMMENTS
	2.2				_	_		Ц,		GRASS @ SURFACE
Bir	&.∂		_	~				Ц		0-25' No RECOVERY
				-				2		
						0				25-6 SILTY CLAY BROWN WE RED MOTTLET
						"		3	=-	25-6 SILTY CLAY, BROWN WIRED MOTTLES
	1								==	
							CL	4	=	
0.0	ه. ک	ije								- Moist Halac .
20	٧.٧	74.2	C 8 0 5	, i		0		5	-	
			E							('105' () 015 50 50 50 50 50 50 50
								6		G-10.5 CLAYEY SANDY SILT, BROWN W
.	2							-	1	WET IN ZOHES WY LAMINAE.
				1			ME	7	1-1-	THE THE PARTY OF T
Ŧ-	-			,0,0		0		1	1.3.	
				25	3			8	V.,	SATURATED IN CORE BARREL @ "B" IN 6"ZONETHAT
\ .	,],, _	2	, -	11				i	LESS CLAYEY.
و.د	3 5.6	14,0	Coor	71		0		9	\	
				1						

	FI	EL	n	L(G	0	F	BO	RI	N	G (CONT'D.) SHEET ZOF Z
	SAMPLER TYPE	z	FEET RECOVERED	SAMPLE	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC	DEPTH FEET)		PROJECT BORING NO. SAKER AFB JOB NO. 3 K98 EIITWIII6
									11	<u>-</u> -	10.5-12.5 SILTY CLAY GREY W REDOKY
i [*]	S.B .	5.0	5.0	1009	1		0	다	12 13 14 15 16		MOTICE, MODERATELY HAND PLASTIC, VERY MOIST: 12.5-20, CLAY, GREY, MOD. SOFT, MOIST, PLASTIC. SOME SILEY ZONES. -REDDISH HEMATITE/LIMONITE C 14-16'
	S.B	S.0	5,0	Court	E1116-02@18		0 0 0		18 19 20 21	11 11 11 11 11	DENER ZONEL ABOVE + RELOW. HOWERE SMALL HEMATITE STAINS 18.5"- 20".
									3 4 5 6 7 C		TD = 2-2-
									8 9 0 1 2 3		
		4							5 6 7 8 9	146 J	
	NOT	ES:	<u>.</u>						ام ل		

* WATER ON COME SACREL @ 21'





SHEET OF 12 BORING NO. **PROJECT** PLAN EAKER AFB たいていいつ LRE JOB NO. 3K9 B LOGGED BY: PROJ. MGR. GVG EDITED BY: 0 DRILLING COMPANY: AW 400 L EIITWIII 7 4 DRILL RIG TYPE: Ha 450 DRILLING METHOD: Ho いるい PAKKING LOF Drillers name: 🗸 BARRAZA 12 TOTAL DEPTH (FT.) DATE 0815 12/17/91 COMPLETED 0826 GROUND-WATER CONDITION AT ABORATORY NUMBER FIELD LABORATORY SAWPLE NUMBER COMPLETION OF DRILLING Saturated zone at + 85' SAMPLER
TYPE
FEET
DRIV'EN
FEET
RECOVERED CODE CODE BACKFILLED, TIME DATE WEATHER CONDITIONS CLEAR, MID 30s, 5 MPH WIND SURFACE ELEVATION COMMENTS Aspitalt @ sweface ŧ., ſ 9 ત્ 2 <u>o-</u>3.5' NO RECOVERNO 1 O BARREL 3.5-5.0 CLAYEN SILT, DARK BROWN C134 ORBANC HORIZON, ИL Sic · W ત ന 5.0'~ 9.5' REDDISH BROWN しなの ረ WI BAFFY MOTTUES BECOMES GREYER ۷ W DEPTH. MOIST TO WET. == MORE SILLY HOPUZONI (SER BELOW) ٥ 7 CL 9 Bridge m でかりかいかい - 8.5to 9.5 WET FREE WATER O VICIBLE IN TWO 4"ZONES Q してるい เก๋ S Ð 9.5-12 WILT BOW MOTTLES Š SOME REDDISH-BLACK STAINS (FO?) PLASTIC, MOD. HARD MOIST



FI	ΞĹ	D)G	01	FE	30	RI	NG	SHEET U OF
PLA		1	1:1							PROJECT BORING NO.
	ļ				CANT	' \] _	1)	!!	EAKER AFB EITTWILLS (ABANDONEN
	į		1:1	ا 		EITWI	0	0	BX	JOB NO. 3K98 LOGGED BY: UNE
ĺ	9	いるしを	عدم	LŠ P	•	.	ε	arteni O	0	PROJ. MGR. GUG EDITED BY: 6FN
		1	["	`	_ ,	Ī	Enti			DRILLING COMPANY: A.W. 600
		STITE	1"	\	~30′		(ASA	100~6("	DRILL RIG TYPE: Howen Stelle Augus
				$-f_{i}^{2}$		Ţ		<u>ق</u> 13ءاس		DRILLING METHOD: Itallow steen Accept
		1 3	# \ \				_			TOTAL DEPTH (FT.) 12
		``	F	لحت (تے)			Œ	TIME STARTED 0855 DATE 12/17/91
	_			\	'A n K	A~1^		4veh.	برد	TIME COMPLETED 0920 DATE 12/17/9/
				₩	₩.					GROUND-WATER CONDITION AT
				ATO	ATOR BER		:			COMPLETION OF DRILLING Saturated Zone at I 8.5'
		ED	_	S S S S S	S S	_	ဋ			BACKFILLED. 16:35 DATE 12-17-91
ER	Z	VER	백은	E	MA	S S	01907	EC		WEATHER CONDITIONS
36	ET VE	FEET RECOV	35			35	문방	F 1		CLEAR, MID 405, LIGHT WIND
S-	E.G	EE	<u> </u>	正る	SAX	至	: <u> </u> 2			SURFACE
•								H	<u></u>	i .
BIT	3.0	0	-	-	-	-	-	H,		ASPITANT @ SMPACE
							,	H		2-5' SILTY CLAY, DARK BROWN
			_			0	-	2	- ,-	TO GREVIEW BROWN; SUGYRY PLASTIC
•										MODERATELY HARD,
İ				e e			CL		- 1	- IMPROCARBON ODOR
									-,-	
	<u> </u>					3			_,-	
S.B.	50	5.0						.	<u>'-</u>	
			1							5-915' SILTY CLAY GREYUH BROWN
			1				٥.		_	I RED MOTTLES SUGHTUS MOIST TO
						ြ	CL			- 8.5 - 8.5 WET IN MERE SIVEY POWES
	-		 -		-		Ctl		-	Two -3=4" zones Here w Free waren
	-		-	94	<u> </u>	30-	ļ	N _	-	
1				8				a a	2 -	
				: F1118						9.5-12 CLAY, GREY WILT REDDISH BEN
SB	5.0	5.3		% 8-1:		ما				METTLES, PLASTIC, MOD. HARD, MOIST
1		}		િ <u>જ</u>		90		10]	
				بــ		i	ſ		-	The second secon

FI	EL	.D) <u>G</u>	`O	F	BC	RI	N	G (CONT'D.) SHEET -OF -
SAMPLER	FEET	9	SAMPLE	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC	DEPTH (FEET)		PROJECT EAKER AFB JOB NO. 3K.98 TWILLS
54	£	PRE	۲,	PAG	c	0		-1/	-	17 12-35-CLAY, GREY: HARD, PHISTIC, ABUNDA
S.B	5.0	5.0	Excrement	l	`[0 0 0	CL	13 4 5 6	1, 1, 1, 1, 1	Fe STAINS AND "NODWES FOLLOWNG OUT ROOT HOLES: MINOR SILT: DAMP 20' SILTY 17'-805' CLAY, BROWNISH GREY W ABWA
S.B.	5.0	40	FRCELLENT	E1119-02-	-1	0 0 0	CL	6 9 90 91	17171	PED FE STAINS + "NCOMES", STEETY STRE -WET C 18' 20' - 21' 20:5/2 - 25 fee CLAY, GREY, HARD, PLASTIC, ABUND FE STAINS AND "NODULES" (SAME AS 12'-17'
								3 4 5 6 7 8 9 0 1 2		TD= 2Z
NOT								3 4 5 6 7 8 9		



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F	FIE		D	LC	G	OF	: E	30	RII	NG	SHEET OF 2
F	PLA								.,		PROJECT BORING NO.
1	1			דו כן	41				N .	4	EAKER AGB BX ShopeHe TW1120
	1	\sim		3) Tu)	~~ o	• •	_	7		JOB NO. 3K98 LOGGED BY: JSB
1				1	·				}		PROJ. MGR. CVG EDITED BY: BFN
-	1			8-					<		DRILLING COMPANY: A.W (DO!
1)			,	, O .	TWI	3 ،		ζ		DRILL RIG TYPE: Mobile 13-61
l		هر ف	1115					O 7	کې _{۱۱ ۱۲}		DRALING METHOD: Hollow stem men
L	\$ G	•						•			DRILLERS NAME: V. Barazza
ſ)		TOTAL DEPTH (FT.) 30
l	-										STARTED 1019 DATE 1-7-92
Ī	<u> </u>						<u>=</u>				COMPLETED 11/2 DATE 1-7-92
İ					₩ 6	SH.					GROUND-WATER CONDITION AT COMPLETION OF DRILLING SATURATED ZORE AT A9' Und 11' and 21'
	Ì		0		E B	A B		G			PACKFILLED. DATE
١	E 3		RE	S	A Z	A S	AN))			TOKA
	교메	드	Š	25	72	70	3C=	5]	FE		col, 45% ptly cloudy, light breeze
	조	PRE	HE CH	SON	덕돌	XX	35	E8			SURFACE
ľ	0,0-	<u> </u>		0.0	- U			7.7	ΪŢ		COMMENTS
Ŧ			•						H	<i>•</i> .	GRASS AT SWAFFILE
١	Aucek 0.2	7		1	. 1	1	ı		H'	• •	
\$72A	٤ ٦								<u>.</u>		DK BROWN - BROWN SILTY SAND W)
1											SOME CLAY, BRUANICS ABUNDANT
9								SM			SAND IS MED - CORREC CISAINED
7										::.	WAL SOLTED ATT + ROLL FRAM.
Sout							0				FRIABLE, MOIST
]		7		0-6,
د د	7		10	2	١.	١.	ن ا	355	Ŋ,		
とうらいていいない	2	フ	m	00			940				DEBROWS - BROWN SILTY CLAY
ī.	İ			l ೨		1	0		4	-	MOIST MOTTLED, PLASTIC
Ŝ				<u> </u>				ł			TR SAND 6-9, 6-12'
-7 °			<u> </u> -	1		 	0	 	W -	│ •	***
			<u> </u> -				12	CL		1: 3	SILTY CLAY TO PROUS TO 9
 /	ن			1.				~			(TET TSIMO OF TSIMOON)
3	50500			3	,					-	
1	1		N)	, 1		4	4	9	<u>.</u>	SATURATED ZONE AT 9': (9-9.5
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	Seu T			COTOS			T		1 -		
Š	21	1	I	1 3	1	l	I	ı	#10	,	SOY CLAY AS ABOVE, SATURATED

11 -1

	FII	EL	D	LC)G	O	F	<u> B0</u>	RI	N	G (CONT'D.) SHEET 2 OF 2
•	SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH FEET)		PROJECT EAKER AGS BORING NO. JOB NO. 3K48. TWITZO
נטאר בפנוך נסאר זפנוך	500013 50003 12-11		5 5	excenent Excerent)	40300011	3C CL	15 16 17 18 19 20 21	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	LITHOLOGY FROM 6-12.515 PREDOMINANT. A SANDY CLAY (CLAYEY SID STATURATED) ZONE & THIVE CONSIDERABLE MORE SAND IC THEM (CLAYEY SAND). GREY-BROWN MOTTLED CLAY W/TR SILT, SE STIFF, PLASTIC-MED. PLASTIC 12.5-27 (SID STRINGER AT 13 CLAY-AS ABOVE - MOTTLEW LAND BECOM
Cour Sper	·	5	>	- שנפות -		1	10000	ИЬ	23 74 75 76 77 28 29 30 1 2		MUCH GRAYER IN COLOR PAPPED WET AT 22/2 ZI J CLAY AS AGOVE SUFF, (SATURATED) PLASTIC, TRACE OXIDE NODULES, AND M COALLE GRAINED SAND. TD=30' Druller reports Clay L. Th
	NOT	ES			\$ ± + ==.				5 6 7 8 9 0		



MWIIZO

FI		Di		G	OF	FE	30	RI	NG	SHEET OF
PLA			==		\equiv					PROJECT BORING NO.
İĨ	,,,		かいて	44				N	1	EAKER AGB TW1120.
L	~~					^	_	ب		JOS NO. 3K9 8 LOGGED BY: 158
			D) Tu 1);	•					PROJ. MOR. C. C. EDITED BY BEN
			8-							DRILLING COMPANY: A.W (201
!	•		•	0	rwn			{		DRILLANGTYPE: Mobile B-61
	~				•	_		3		DRILLING METHOD: Hollow sing anger
PARIS	<u>س</u> (105					0	ا پاله ادمو		DRILLERS NAME: V. Barazza
थ										TOTAL DEPTH (FT.) 30
										1019 DATE 1-7-92
1										COMPLETED 11/2 DATE 1-7-92
				2	Z.					COMPLETION OF DRILLING
					운동					Sominfed zone at 29' und 11' and 61'
		<u>e</u>		63	53		2			THE 1/9/12 SEE WELL WINDLESTE WEATHER COMPTIONS
E		5	니티	34	34	3	9		1	WEATHER CONDITIONS PHIN clunder, light breeze
鲃	E	뎚		35	85	32	울병	5.5		
弘	반동		88	23	23	垩	38	185		EL CATTON
								Ц		COMMENTS
3 2		٠			1	,		Ц,		GRASS AT SWAFPIG
30	7		1			·		H '	<u> </u>	
								H.		BK BROWN - BROWN SILTY SAND W/
<u> </u>]							Н	·- :	SOME CONT. ORGAN.CS ASUNDANT
•					}		SM	Hs.	-	SAND IS MOD - COOLES (PAINOD
	1 1							H	\ ; ; .	LIGH SORTED BTT + 1)CA FRAME.
		 ,				0				FRIAGUE MOIST
		!						22		0-6'
7.2	5	·V	Ç	١,	١,	94	159		1	DEGROUN - SREWN SILIT CLAY
7		m	5000			<u> </u>		7	. :	MOIST MOTTLED PLASTIC
٦.5			3		1	0		4	7.5	(6 (12)
			1			0	ľ	l_{ll}	=:	TR SAND
┼-		 	_	-	+	├─		*	† <u>-</u> -	SILTH CLAY AS ABOUT TO 9'
		•		1		2	دب		-	(LT Blow) TO BLOW !
500.5			1						1::	
Sent Tebe.	!		3							SATURATED ZONE AT 9' . (9-1.5'
1 10	7	12	אנפונטא			4	4	I,		
۾ آخ			1 3							SOY CLAY AS ABOVE : SA WANTED
₹ }	1	ı	1	•	1	i.	•	W. K.	?• –	20-1 11-11-5'

		8	5 5	9 9	2		RI	N	PROJECT ENKED ACS BORING NO. JOB NO. 3 Kg & TWILZO
SAMPLER TYPE FEET	TECONE TECONE		FIELD L	FIXED I				-	
1201		tercent			403	3€ 3€)1 -15 -14	S. 18 (1).1	LITHOLOGY FROM 6 - 12.517 PREDOMININTLY A SANDY CLAY (CLAYET SD SISTURATED) ZONEC MANE CONSIDERATILE MORE SAND IN THEM (CLAYET SAND)
3	3/3	J EX)	0 0	r.	15 16 17		STIFE , PLASTIC - MED PLASTIC 12.5-27 (SD STRINGER AT 13')
50007 17-22	5	त्रका प्रभाव	-		1	¥	20 2/		CLAY : AS ABOVE - MOTTULE :- DECREPCES BEOW 18.5' CLAY BECOME
22-27	5	prenovr		7	0000	ИL	25 24 25 25 26		PLASTIC, THACE ON DE NODULTS AND ME
Aubort 10 30' 27-30	, ,	J	1	Į	· 1		20 20 20		TD= 30' Doubles resorts
		ala	an a		t we≱k		25456789		- land to The

Halliburton NUS FIELD LOG OF BORING CORPORATION

WELL NO. MW1121 SHEET __!__ OF ____

		77	. 91						_		_		
PRO	JECT:			EA	CER	AFB	RFI		JOB			01	14 BORNGWELL NO.: MW112
									rog	QED	B 1	<u> </u>	BDH TOTAL DEPTH OF BOREHOLE: 16.7
DRIL	LING	CONT	RACT	OR:				Testi	ug				SURFACE SLEV.: DATUM:
DRIL.	LER'S	NAM	E :	140			142					-	START TIME: 018 DATE: 4/8/95
ORE	L NIG	TYPE		<u>" C</u>	ME	ار	<u> </u>		·				FINISH TIME: 0920 DATE: 4/8/95
BOR	NG M	ETHO	D <u>:</u>	H5	<u>A</u>								WATER DEPTH:
HOL	E DIA	METER	R:	フも	"	ا م	<u> </u>						DATE:
SAM	PLING	MET	HOD:			Sugar.							TIME:
HAN	MER !	WGT.	:	N			T	P HQT	r: /	14			BACKFILLED, TIME: DATE:
SUR	FACE	COND	ITION	18:	1	nn	v						WEATHER: Fair, lo 603F very stony wind, quite
SAMPLE MITERVAL	SAMPLE TYPE	BLOWS / 6-NCHES	NCHES DRIVEN	WCHES RECOVERED	OVA READING (ppm)	MOISTURE	DEWATY	MUNSELL COLOR	LAB GAMPLE HUNGER	DEPTH IN FEET	CONTRACTOR STATE OF THE CONTRACTOR CONTRACTO	LTHOLOGY	SKETCH OF BORING LOCATION
en a a a car references	<u> </u>		Tetesto.	**********				emissis:	* 6 767 A 44				MATERIAL DESCRIPTION
	i i			•		5)		107	β.	•	Ц		
					0	2000	, श्रम	413			Ш	1.1	0.5-1.1' Silt, clayer, say,
	•				D		برايم	1031		ر	Ħ	•	southers, sh. moist, liam
			,	Γ,				6/3		1	П		1.1-29 Sand well sorted lie
2.7			27	2.7		<i></i>		WYP	2.7	١,		2.4	and now make brown
_								7/3	3.2	3.	O		2.7'-32' E11 -54 - MW112 IA @ 0332
1			51		0			3/2		, ,	П	7.0	2.9-4.0' Clay, silver, mina sol.
-				3	l			ر الأور	ŀ	ľ	Ц		very mink to wet at the work or
				Ĺ.				4/2		_ ا	Ц		3.4" von dech march lon
					0	40				'			nottled isolal / vange on.
							M	<u> </u>		. .	Ц	÷	4.0' - 13.8' Class, silver, Bran.
											L		moreled, orange by, die gray
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<u>1.7</u>					0	~64	8						
7			امر	2.8	[Ц		
1			3								U		
V] .			
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NOTES: EDITED BY/DATE:_

Halliburton NUS FIELD LOG OF BORING

WELL NO. M 4/21 SHEET 2 OF 2

~		<u> </u>	<u> ICUD</u>	AIIL	<u> </u>					_	-		
PRO	JECT		EAKER AFB RFI								- 1	NO :	0114 BORING NO.: M V//2-1
INTERVAL	SAMPLE TYPE	BLOWS (G-WCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	37((1532)(1534)(1534)(1534)(1534)	LITH.	
11],,	Н		11.7' Clay, loss silt contex, is fin
П				1				рγλ]‴	H	1	
4	-	-		-			2	1 4/)		[" [?]	ti		
12.7		-	<u> </u>		0		gin	┼		, , -	H		
1),,),,	Ц	12-8	13.8'- 16.3' Clay, al siles frien
7			2.6	2.6	0	2000	gi.,	yoYA Y/I		,5.	Н		redish est blong old frostmer.
1											H		
163										16.	H		
										ירו	Н		
		-									H		
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		,	ek	- AS ⁽¹⁾	A.s., 277	, 12, , , , , , , , , , , , , , , , , , ,	r a Tibur	£ in	wi.:	a ·	,	N.	
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NOTE	£-											^	FOITED RYDATE:

_ EDITED BY/DATE:_

Halliburton NUS FIELD LOG OF BORING

WELL	NO.	MW1122

	1		າ.
SHEET	,	OF _	

V)	V	COR	POR	ATIO	N								
PROJ		المناسب				AFB F	₹FI		JOB	NO.:	0	114 BORINGWELL NO.: MW/122	_
- 114	i		٠	11		 '	-			CED !		BOH TOTAL DEPTH OF BOREHOLE: 17.9	
рен -	LING (CONT	RACT	OR:		Tri-S	tate	Testi	19			SURFACE ELEV.: DAYUM:	
	LER'S			Ope	. 1	FA						START TIME: 1236 DA'E: 4/7/95	
	RIG					-5						FINISH TIME: 1430 DATE: 4/7/95	
	NG M			H	_							WATER DEPTH:	
	DIAN			つも	· //			_				DATE:	
	PLING					Tuy	س					TIME:	
	MER \			N				Р НОТ	: A	A	, , <u>, , , , , , , , , , , , , , , , , </u>	BACKFILLED, TIME: DATE:	
	ACE				_	nos						WEATHER: Fair, upper 70 3F, contaly and	
SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	MCHES DRIVEN	NCHES RECOVERED	OVA READING Ippm)	MOISTURE	DENSITY	MINNEEL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	UTWOLOGY	SKETCH OF BORING LOCATION	
	27			in action	and Andrew	e saljuna	:					MATERIAL DESCRIPTION	
				[]	0	اسرا	الكيد	2.57			Ц	0.5'-1.1' Sand, fine grained, silvy,	
0.5					Ľ	10	770	4/4	<u> </u>	۱, ۱	سلل	1 st. clargy, Northers, wind him	
					0	ر ۱۰	عبر	2.5Y	1			1.1'-1.8' land, five grand, silvy,	
					L	الامعر		6/4		,	ود[st. mix, lister wellowing & born	
V			27	25			,	254				18'-32' Clay sandy at ton silvy	
2.8					0			412] ,	0		<u> </u>
									\Box	וין	ريد []	and grayed from, sould orange to	
	 				0				1		[]	3.2'-5.1' Clay inter laster die low	L 7-1
						•		2.5		"-	П	moreled mana hu man of	7
,					0	Page 1		51)	•	ا _ ا		4.8'- 5.3' E11-54- MW222A @ 125	0
		-	- 1		_					5-	1 Fel	51'-62' land nove l'a a mati de	Qe.
			5.0	5.0	0	بمد	100	7.5 VD			Ħ.	plie Inne wat	لردمد
-			1		<u> </u>			I — —		169	1462	- 62'-77' Clan ile Promo all Il.	d.
					0	Kyn	Ť I	1/9	1		П	nama Bran min	7
			—		 	†		1 "		7-	Ħ	7.7'-9.1' Rad way Lizared sales	٠.
ام.					{			.			727	4 Pala ship Brown and	_
28					 		A	2.5	-	8-	H	No. of the last of	
					0	إنجعا	poper	513			H	01-11-2' 10. 0 1.01 0.	l.
				-	 	 	-		 	17 -	Han	1 Donal . M. Mary , marked the	
4						mis	*	1017	1		H	committee the son of the son of	
MOT	ES:	<u></u>	_					<u> </u>	<u> </u>	TIO.		EDITED BY/DATE:	

Halliburton NUS FIELD LOG OF BORING

WELL NO. MW1122 SHEET 2 OF 2

77		CU	POH	AIIL	71/4					1-	_		
PRO	JECT		EAK	ER A	FB RI	FI	,	,		OL	8 (10.:	0114 BORING NO.: MW1122
INTERVAL	GAMPLE TYPE	PLOWS / 6-NCHES	INCHES DRIVER	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	BAMPLE NUMBER	DEPTH IN FEET	FORMATON OF STREET PARTICULARIES	стн.	
								- 3		 ///-			
1			5.0	5.0	0	دنىد	fin.	2.5Y 5/2			h	11:7	
h.8										U.			11.7'-17.9' flag, al. siley, grayish from; norther manger bu to bedder from along frottens.
	-	-			-					η.	1		
		-						-		5-	H		
										14.	H		
										17-	H		
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	L S:					!					<u>.</u>		EDITED SY/DATE:

EDITED BY DATE:

SENT BY:BROWN AND ROOT, ENV ;12-21-95 ; 4:23PM ;

Halliburton NUS FIELD LOG OF BORING

WELL NO. NW 1123

CORPORATION

(A) ERT __ _ _ _ _ _ _ _ _ ____

PROJECT: EAKER AFB RFI	JOB NO.: (C)	<u> </u>	BORING/WELL NO.: MW 1123
	LOGGED BY: 6	> Millar	TOTAL DEPTH OF BOREHOLE:
DRELENG CONTRACTOR: Tri-State Testin	9	SURFACE ELEV.:	DATUM;
DRELLEN'S NAME: John Crawf	ord	START YME: 15 S	5 DATE: 8/11/95
DRILL RIG TYPE: CALE 75		FINISH TIME: 17:3	DATE: 9/11/95
BORNE METHOD: 7 14 HST EVER drille	rd with	WATER DEPTH:	
HOLE DIAMETER: 101		DATE:	
SAMPLING METHOD: CONTINUOUS S	ampling	TIME:	
HAMMER WGT.: NA DROP HGT:	NA	BACKFILED, TIME:	DATE:
SURFACE CONDITIONS: Grassy	والمساول والمارية والمارية والمارية والمارية والمارية والمارية والمارية والمارية والمارية والمارية والمارية و	WEATHER: 1-10+;	Humid: 95°F, Sunny
SAMPLE TYPE SAMPLE TYPE RLOWS / C-MCHES MCHES DRIVEN WCHES RECOVERED OVA READENO (ppm) MOSSTURE DENSITY MUNSELL COLOR	CAB SAMPLE NUMBER DOPTH IN PRET MONTHLOAN LITHOLOGY		OK STUDENT P: FC
			MATERIAL DESCRIPTION
15 40 NA 35T 35T 0 134 34 34 34		0.5-3.01	- Sandy SILT; some
10111		Clauri	the yellowish brn; color
0/	SM	Chance	
			brn then back to
0/ 24/34	Z		at off sandis
			uar: Well sorkd. 31+
1 80 35 6/ WAR		, , ,	e; multieje roots 4
			ess roots to 3.01.
	N.		
/0		3.0' - B.6	1' - SILT; trace vea
			ingular grains: trace
			yellowish bing some
			osts + reals; mattled
	<u> </u>	WIJOU	R416 dk viellowish
			appears isminated
	ַן וו	, , , , , , , , , , , , , , , , , , ,	
5F 3.5 0/591 Y X MAYE		8.0' - 9	5' - SIL trace
		Sand 'v	ifa bro wiours/6
	7	Vellow	ish brn rootling.
6 20			J

EDITED BY/DATE:_ NOTES:_



Halliburton NUS

FIELD LOG OF BORING

WELL NO. MW 1123

SHEET ___OF ____

~		_	RPO	NA.	IUN						_	_			
PRO	ÆCT	<u> </u>	EA	KER	AFB	N	1				ەد ا	-	iO.:	0114	BORING NO.: N. WII 23
INTERVAL	GAMPLE TYPE	BLOWS / 6-INCHES	MCHES DAIVEN	RECOVERY	M/A 6		MOISTURE	DENETTY	40700	GAMPLE NUMBER	DEPTH IN FEET	the section of the section of	LTR.		
Π	П	11	Πi	П	0	/	WEI	34	T	П	T			9.5' - 13.01	- Clayer SILT
⊬	╀	╁┼	++	╂┪	1	위	+	H	++	╂	- n	F		trace Vfg san	d; brn some
	Ш	Ш	Ш	L			1	1	<u>L</u> '		12	П			o Hed will oursil
1		\prod	T		T		•					H		yellowish brn	; SIX plastic
ſ	893	11	35	5:	7	7	والج	2.4	372		13	Ħ			
4	J. ob	11	4	11	4	잌	4	1	11	<u> </u>	14		- _L .	13.0' - 15.0' -	CLAY . trace
			Π	Π	19	引	1					ſ		Silt; grayis	
	十	++	╫	++	To	7	1	5.7	101C	┢	10			· · · · · · · · · · · · · · · · · · ·	or casts , worm
		Ш	1)	Ш		Ó			"],_			W/ 2.5 PAIL	dk red siltn
		II^-	Π	\prod	10,	7					7			sand materic	
4-4	┿	#-	₩	#	K/	4	1-1				17	ı	- 1		Il intact, Some
13		11	11		1%							I	ŀ	Chliche; 511.	plastic
1	十	#-	15	12	10	7	┪	1	HH		16	R	ŀ		
	1			Ш	17	<u> </u>					19		l	15.0'- 19,5 - CL	AV . trace Silt.
71)	-	П	\prod	19	7		华	7		'7	A.	_[some worm
			 	 	╀	+	-	भःस			20	H	-	burrows i roc	t cast but not
- 1						ı						Н	ŀ	as many as	13.0-15.01
_				-	†	†						Ħ	ŀ	Worm burrow	naterial: not
												ď	Ì	plastic unt	1 ~ 19.0" When
					Π	Τ								more silt is	noted. No
	_		 	 	 	1	_			_		Ц	Ļ	Norm burrow	s I root custs
ŀ						1		- 1	ľ	İ	ŀ	Н	ŀ	below 18.01	but some
					╫┈	╁	-			-	l	Н	ŀ	chliche hot	a.
	4,0		2417.	.3.		1	\Box		ate hay	ι 6 .	Sp. Car	(3)			
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NOTES:

EDITED BY/DATE:

CORPORATION

Halliburton NUS

;12-21-95 ; 4:24PM ;

FIELD LOG OF BORING

WELL NO. MW 1124

SHEET		٥F	
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0114 EAKER AFB RFI PROJECT: JOB NO.: BORING/WELL NO .: A W 12 4 G. millar LOGGED BY: TOTAL DEPTH OF BOREHOLE: **Tri-State Testing** SURFACE ELEV.: DATUM: DRILLING CONTRACTOR: John Crawford C930 DATE: 3/12/95 START TIME: DRILLER'S NAME: 1.915 DATE: 8/12/95 FINISH TIME: CNE-35 DRILL RIG TYPE: BORING METHOD: 7:14 HSA GVEY OVILLED WID'HSA WATER DEPTH: HOLE DIAMETER: 10" DATE: sampling method: Continuous Sampling TIME: DROP HOT: NA HAMMER WGT.: NA BACKFILLED, TIME: DATE: WEATHER: 140+ SURFACE CONDITIONS: Grassy 95°F : SUNU Jirch MWITZ wwitzy . NCHES RECOVERED NCHES DRIVEN Be Suppelle Sketch of Boring Location MATERIAL DESCRIPTION anjular uellowish brn 34 Cohesive color. 3.51 - 4.51 - Clauser 3127 . You die arque 丈 or chance brn W1 104R416 red mottl areuish bro

NOTES: drived to determine if contaminate REDITED BY DATE:



WELL NO. MWICZY

7	"		RPO										SHEET OF
_	OJEC1		-		AFB F	VFI					JO	B NO.	: 014 BORING NO.: MW1124
INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	WCHES DRIVEN	RECOVERY	OVA beni	MOISTURE		DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	типольки применения - ИТМ.	
\prod		\prod			%		3 5	4:1	学				trace sand ufg: trace clay, more
	\prod				16							A C C	motived throughouth W/dx unlowsh
13		\prod			%								
lŤ	#	#	351	90	0/	7	가갈	ø	T		73		9.0' - 14.0' - SILTY CLAY
十	╫╴	#	╁┼╴	╁	0)	#	- 13		ioie Wi	<u></u>		-	reats: Some intest carbonized
#	#	$\!$	₩.	$\!$	0	ightarrow	H	4	-	SIS	,		mot structures, aren w/ 254R
	11			Ш	1/6	\coprod	Ш			<u>بر</u>			4/9 dr red; plastic
					0/0	\prod	\prod	T		ואעק			140'- 1901 - 01
+	11			1	%	Η-	#	1	H	र	17		14.0' - 18.0' - Clay; were Sitt
<u>/a</u>	++	#-	91	<u>त्र</u>	27	Tools	13		H	8	15	4	filled wil love 518 yellowish han material. Some pot casts +
+		-		1	6	THE THE	ĮĨ	1	41	a	19	CH	worm burrows. The verticle
					%					Щ	26		Seam ~ Binches in length begins
					%		\prod	T	\prod	4			
+				1	%	+	H	†	H	F	7		more where burrows; roofcasts
╂		-	-	+	<i>。</i> /	200	H	+	╀┤	ĕ	-		vorticle seams filled w loyests
13		\perp	المداد		<u>/</u>	1	\coprod	\downarrow	\coprod	۲	23	 	extends from 21.5' - 22.5'.
\perp			1	7.5	%					ŏ			from 22.01 - 22.5:
Τ	ř.	y, 19	(3)		%	53	\prod		П	34	,	C-	
+		+	+	$\dagger \dagger$	0/	+-	H	\dagger	††	_	25	} `	sand is med arained angulari
╁┤		┼┤	++	╅┩	<u> </u>	501	-241 -1	14.0	ᇩ	AMP.	2.6	 	Well sexted; ax avery wil some
4	-41	$\perp \downarrow \downarrow$	$\downarrow \downarrow$	$\downarrow \downarrow$	0	\coprod	Ц.	1	╂┼		· 27		Jak sie mottin so no very
24		\coprod			9					9	R		burrows.
	14.5	\prod	is FIT	120	2	\prod	T		П	T)	٠٠	SW	Dig 38.01 - SAND; men grand
H	77	††	71		0/	11	+	#	+	寸	역		Jellowish bon.
b	1	1	1	l L	0	} [1	П	1	- 1.	. , [t l	

NOTES: & Soven ft. of blowin at 28'. Off. EDITED BY DATE:

→ 13038318208;#12/21

M	Halliburton CORPORATION	NUS
W	CORPORATION	

FIELD LOG OF BORING

WELL NO. MWIIZY

CHEET _____ OF ___

PRO	JECT	<u>. </u>	EAL	(ER /	\FB R	FI				JOI	NO.:	미니니	BORING NO .: NW 1124
MITERVAL	SAMPLE TYPE	BLOWS / BAICHES	MCHES DOVEN	RECOVERY	OVA bpmi		DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	רנוא		
- Se						50.7		700	NACYSIS	19 33 34 37 39 37 39 37 37 39 37 37 39 37 37 39 37 37 39 37 37 39	NUT S	281-381-1059	sempline from

EDITED BY DATE:

13038318208;#13/21

SENT BY: BROWN AND ROOT, ENV ;12-21-95 ; 4:25PM ;

Halliburton NUS FIELD LOG OF BORING

WELL NO. MW1125 4HEET ____ OF ____

		COR	<u>POR</u>	ATIO	<u> </u>							
PRO	ECT:			EAK	ER A	\FB F	RFI		JOB	NO.:		BORING/WELL NO.: MW/1/25
									LOG	aed i	ry: 6	Millar TOTAL DEPTH OF BOREHOLE: 28'
DRIL	LING (CONT	RACT	OA:		Tri-S	tate	Testic	ng			SURFACE BLEV.; DATUM:
	LEN'S	_			מנ	Cre	ىس	£	4			START TIME: 0928 DATE: 10/31/95
_	L RIG											FINISH TIME: 0925 DATE: ///0//95
					-		rdr	ille	l W	10.	HSA-	WATER DEPTH:
_	I DIAN											DATE:
	PLING				מלדר	Uni	25.5	50.7	n el	ine		TIME:
	MER I			JA					r:			BACKFILLED, TIME: DATE:
SUPE	FACE	COND	ITION	18: (<u>5-70</u>	33	u					WEATHER: Overcost: 50's - 70's : sit breeze
SAMPLE INTERVAL	BANPLE TYPE	BLOWS / 6-NCHES	NCHES DRIVEN	INCHES RECOVERED	OVA READMIG (ppm)	MOISTURE	DENSITY	NUMBELL COLOR	LAR GAMPLE NUMBER	DEPTH IN FEET	UTHOLOGY	NUMBER OF BORING LOCATION
		cywie Cywie			Ť						X P. N	MATERIAL DESCRIPTION
	70	100	22	ON CLARY			A.T.C.			2 4 6 8 0 %Z 44 14		See boring log for MWI124, drilled Bliz195 for description of lithology from Surface to 18.0. Summany of lithology from Surface to 18.0: 0.0:-1.5:- Clayey SILT 1.5:-2.3:- Sandy SILT 2.3:-2.5:- SAND 2.5:-4.5:- Clayey SILT 4.5:-9.0:- SILT 9.0:-14.0:- SILT 14.0:-18.0:- CLAY
Γ	2314	^^	5F1	357	%	***	34	3		18	سات	
11	2 L	1 I -		1 [1/0			. 1	1	1_ I		

NOTES: Dilled to determine extent of Contamin- EDITED BYDATE:

SENT BY:BROWN AND ROOT, ENV ;12-21-95 ; 4:26PM ;

Halliburton NUS

FIELD LOG OF BORING

WELL NO. MW1125

SHEET 2 OF 2

CORPORATION BORING NO .: MW1125 JOB NO.: 0114 PROJECT: **EAKER AFB RFI** NCHES DAVIEN Ę 18.0' - 20.0' - 51 Hy CLAY: Claver SILT: brn. WIOUR 5/6 vellowish brn. motting: some root structures and 22 warm burrows. 23 6 CL 20.0' - 21.0' - CLAY trace Silt: dk gray; some brn 10485/3 SN 21.0'- 24.5' - Sandy CLAY dk gray; sand is prorty sorted some mud, and some fa sand, angulas: @ 24.0' Ts a zinch verticle sand seam sand is fa tomed grained syrsis yellowish red and angular. 24.5' - 25.0' - SAND; Well Sorted fa sand; angular; gray 25.0'- 25.5' - SAND; poorly sorted ma-fa; anguar otz. some coarse arains musticolored as ains, overall color loursib Vellowish 25.5'-28.0' - A3 above TO = 2200 Heighster TO= 38

EDITED BY/DATE:

Halliburton NUS

FIELD LOG OF BORING

WELL NO. MW 1126

SHEET 1 OF 2

	CORPORATION CORPO											
PROJ	ECT:		i	EAK	ER A	VFB F	RFI		J08	NO.:		114 BORING/WELL NO.: MWI126
									LOGG	ED I	Y: G	F. MILCO TOTAL DEPTH OF BOREHOLE:
			RACT					Testi		•		SURFACE ELEV.: DATUM:
	ER's	NAM	E: -	Jor	מכ	<u> </u>	w	160v	<u>-d</u>			START TIME: /0 27 DATE: //0/195
				ME								FINISH TIME: 1900 DATE: 11 07/95 9 700 MATE:
BORR	NG M	ETHO	0:7%	4" <i>H</i> ≤	SA O	verd	will	ed v	<i>م، ا</i> د	" H:	SA_	WATER DEPTH:
HOLE												DATE:
					nti	nu	5US	\$ 50	ורע	زام	79	TIME:
HAM				NA				P HGT				BACKFILLED, TIME: DATE:
SURF	ACE	COND	ILION	18:	Gr	0.55	su.					WEATHER: Over cast 50's - 60's
BAMPLE INTERVAL	EAMPLE TYPE	HOWS / CHICHES	nches driven	MCHES RECOVERED	DVA READING topmi	MOISTURE	DENGITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN PEET	LITHOLOGY	ANUAZZ SHOOPSTIE TO MANUEL
									- 3			MATERIAL DESCRIPTION
	Ma.	4	20		NO TO THE PARTY OF	Q XS				2 4 9 8 10 12 4 16 19	x_{ij}	See boring log for MWII2! Apr lithology from 0.0'-18-6'," Summary of MWII2! from 0.0'-18-6''''s below's 0.5'-1.1'- Sandy Clayey, Sict 1.1'-2.9'- Sand, Eg. 2.9'-4.0'- Silty CLAY. 4.0'-13.8'- Silty CLAY. 13.8'-16.3'- CLAY.
18	(200 (200) (100)	17	SET	3.3	%	200 \ \		437			CH	

NOTES: Drilled to determine presunce or absence of contamination.

EDITED BYDATE: JUL 2011 11/20176

Halliburton NUS

FIELD LOG OF BORING

WELL NO. MW1126

SHEET 2 OF 2

CORPORATION PROJECT: EAKER AFB RFI 0114 JOB NO.: BORING NO.: MW/176 Ē 33 8.0'-20.3' - CLAY; 314. Plastic alk gray: some root structure + worm burrows. 化升 20.3'-21.3' - As above WI color change to brn. 0 53,0'-25,0' - CLAN : 307L send; poorly sorted angular 0 med: Coarse 25 avair. worm Some root casts 76 اعا Ailled WI burrows, veins vellowish red silt. Some mothes 25.6' - 28.6' -Sandy CLAU dk gray: anoular: focoarse onaused, voins filled OURS sP 0 5-**/**o 28.0-29.2'-Sandy CLAY SEIND ' med colored mairis TO = 41 CWell in statled at - THOUGHT TO BE SAND BASED ON BRUL CUTTINGS AND ADJACENT BOAR HOLE ONTH.

NOTES: Due to recommity of ACTACENT HOLES & TIME LIMITATIONS, EDITED BY/DATE: JRGIL 11/25/45 A COMPLETS SOIL DESCENPRON NOT PERFORMED @ TICL LOCATION

FIELD LOG OF BORING Halliburton NUS

WELLNO, MW1127

SHEET / OF 2

CORPORATION 0114 BONINGWELL NO.: MW/127 EAKER AFB RFI JOB NO.: PROJECT: TOTAL DEPTH OF BOREHOLE: 28.0" LOGGED BY: G. Millar DATUM: SURFACE BLEV.: DRILLING CONTRACTOR: Tri-State Testing 1634 DAGE 11/02/95 DRILLER'S NAME: John Crawford START TIME: DATE: 11/08 /95 1400 DRILL RIG TYPE CME - 75 FINISH TIME: BORBIG METHOD: 71/4"HSA Overdrilled w 10" HSA WATER DEPTH: HOLE DIAMETER: 104 DATE: EAMPLING METHOD: Continuous Sampling TIME: DROP HET: NA HAMMER WGT.: NA BACKFILLED, TIME: DATE: SURFACE CONDITIONS: Grassu WEATHER: Over cast breezy: 40's - 50's NCHES RECOVERED DVA NEADING topi NAME INTERVAL LOWS / CANCHES HUNSEL COLOR GAMPLE TYPE HOISTURE MWIIZT O SKETCH OF BORING LOCATION MATERIAL DESCRIPTION See boring log for Mulli drilled 12/16/11 from 18th surface to 18.0'. 18.0' - 19.0' - Silty CLAY/ Clayer SILT muticle snjall root

NOTES: Drilled to determine the absence or presence EDITED BYDATE: #49lle 11/28

Halliburton NUS

FIELD LOG OF BORING

WELL NO. MW1127 SHEET 2 OF 2

CORPORATION 0114 BORING NO .: MW1127 JOB NO.: EAKER AFB RFI PROJECT: PLOWS / BANCHES **IAMPLE'N'UMBER** NCHES DRIVEN DEPTH IN FEE BAMPLE TYPE OVA topm) RECOVERY MOISTURE MTERVAL COLOR Ë 211 structures Iworm burrows filled WI SUR SIS vellowish red material Inveral Color brn C. 9.0'- 24.5' - CLAY SOME SILT - root structures / worm burrows to 21.0' then less root structures but some loursia brn. mottles, some 5W fg-mg, poorly sorted sand. overall color de gray 24.5'- 26.0' - SAND, Vfg-fa SP Well sorted; angular, dk aray Peat-like material from 23 25.0' - 25.2' ak black 26.0'-29.0' - Vfa - ma SAND Welterm. poorly Sorted, brn, angular grains gtz **6**, 1D= 23.0 36.5

NOTES: DUE TO PROXIMITY OF HOLES & TIME LIMITATIONS A COMPLETE SOIL DESCRIPTION FOR PERFORMED FOR HOLETE @

EDITED BY DATE: JAGOLIA

This Location.

· Halliburton NUS

FIELD LOG OF BORING

WELL NO. MW1128

\$HEET ____ OF _3_

		CO	3POF	ATI	<u> </u>									\$112	=1	. 	
PRO	JECT:	:		EAI	KER	AFB	RFI		JOI	NO).:		0114	Boring/Well N	0.: ML	ון ע	28
L									LOC	GEI) [IY: (5 Millar	TOTAL DEPTH C	F BOREHO	LE:	10.01
DRIL	TING	CONT	TRACT	ron:		Tri-	State	Test	ng				SURFACE ELEV.:		DATUM:		
DRIL	LER'S	HAR	AE:	اه	20	Circ	سه	%	rd			•	START TIME:	525	DATE:	111	03/95
			i:										FINISH TIME:	800		•	5/95
BOR	NG L	ETHO	XD: 7	7/4"	HSF	+ 0.	جااب	d 4	40	ug	ے	_	WATER DEPTH:				
HOL	E DIA	METE	00: R: 12	پېي	v fa	CE .	7%	4 4	3 -	10		<u>, ر</u>	DATE:				
			THOO:										TIME:				
		WGT.		N			_	P HG				7	BACKFILLED, TIME:		DATE:		
SURI	ACE	CON	omo	VS: /	950)ha	J+						WEATHER: CICAL	: Sunnu :	bree	ال ال	42°F
		1		Π	Γ			Ì		Τ					A SIL MONTH	age '	
يا		ı,		a	Ē			j	LAB GAMPLE NUMBER	ı			5803	5	DAWII2	*/	
SAMPLE INTERVAL		BLOWS / 6-INCHES	2	NCHES RECOVERED	OVA READING (ppm)		l	MUNEELL COLOR	₹	15			Juil _	Bx	Heard.	/	CHW1126
E	AMPLE TYPE	₹	NCHES DRIVEN	<u>ឆ</u> ្ន	夏	<u> </u>			1 2	DEPTH IN FEET		5	MES	11	S .		@ MWIIZI
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		******									T		Surface			L S.	مسماط
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	16	b.									H		JAL SPILES	Corp Heat 1	- 1		Crow)
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NOTES: Dilled to delermine presence or EDITED BYIDATE: Helle 11/20/95 absence of contamination in the Sand aquifer

Halliburton NUS FIELD LOG OF BORING CORPORATION

WELL NO. MW1128

SHEET 2 OF 3

PRO.	JECT:		EAK	ER A	FB R	R				14	DB NO.;	0114	BORING NO .: MW112
WTERVAL	SAMPLE TYPE	BLOWS / B-NCHES	INCHES DRIVEN	RECOVERY	OVA (ppml	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITM.		,
,	25 27,0	NΑ	30	3P	10%	74. 	150	132	2		ML	brownish grav	. MoHledwy
+				П	40%		$\parallel \parallel$					104R5/3 brn.	metties.
+	- -	11	1	+			什	11	+	†'Z	سل ا	11.0'- 12.5' - CLF	14 : some silt:
4		$\perp \! \! \perp \! \! \! \perp$			کور ماجار	Ш		12Y	1	-1.3		brownish ara	
13	\top	$\Box \Box$	5-1	551			П	TT		7'		5/4 yellowis	
					70/			<u> 11</u>	<u>.</u>	$\mathbf{J}_{\mathbf{Y}}$			striworm
TT	\top	\Box	77		3/2		П	П		7		burrows: 50	me mocts still
	\bot					Ц_	Ц	14.		ڪاـ	ک ہے	intact; <11.c	plastic
		11	11		2%						CH		
\sqcup	4-4	44	44		15	_	Ц.	₩.	_	اءرا		12:5-17.0' - CLAY	trace silt:
	11	11	11		2%			Ш	l	ĺ		plashe, ben	· mothed w/
╁┼		44	┵┵	-	72	+	4		<u> </u>	12		104R 5/6 4	ellowish brn
1		11	II		5/	1		147	1	ŧ			Horm burrows
<u>3 </u>	++	+4	5=-	1			4	1-1-	 	18			c mother, some
8			771	"i"	3	7	22	1 1	ł			intact roots.	
┾╼┾╸	1 1	┵┼	╌┼	┵╉	451	+4	+	╀		М	ı		
!	1	II	11	14	10%	A]					17.0' - 25.0' - CL	
┼┼-	╅┪	╂╌╂╌	╌┼	╂╼╫	O.	nes	+	! -	_	70		dk gray; one	nbly texture
	11	Π	11	<u> </u>	%	1.						Vertile root ca	sts w/roots
╁╌┼╴	╬╌╁╌	╂╼╂╌	╌┼	11		+	+	┝	_	ય			me are 4-5
	11	11	11		2/3	11						inches in lengt	W. Along
┾┿	┿╅	╂┼	╁╂	╁╂	70	╁╾			_	22		roct casts is	yellowish red
	11	11	11	١,	9						R		ng; Some love
3	╁╌╂╴	++,	,	3		╁┤	+			23			1es, Product
	11	$ \cdot $		1	9	П						from 18.51 to	
╁┼╌	++	1 †	H	-		╁╾╂	1			24	H		
		1.1	11		ŀ		1				H	also noted all strong oder.	
3	++	1 9	=1	301	0/	††	+1		-	ಶ		Serence enter.	
	41) [/6	-						25,0'- 28.0 - 6	ALLIA
$\dagger \dagger$	++	1-1-	11	11	0/	Ħ	77			74		above	. ,
11			П	1 1	6	1				R			
H	77	††	11	1 1	0/	71	7			~		29.0' - TD - SAM	JD. fa-med
8			<u> </u>	1 1	/ol	بازرا	42	'2. \$					1 to led W/
7	20	71.			1		42			28	44		multi Colore
		7	14	الك	ا رو					24] 5 55	grains (with but	conal) overall
			T	T	-	X					Sw	delar brownish	cacia.
- 1	- 1	- 1			- 1		7	\neg		30	7		· · · · · · · · · · · · · · · · · · ·



WELNO. MW1128

SHEET 3 OF 3

		COR	POR	ATIC	<u> </u>									
PRO.	JECT:		EAK	ER A	FB R	FI	·	·		10	_	0.:	0114	BORING NO.: MW1128
INTERVAL	SAMPLE TYPE	BLOWS / G-NCHES	INCHES DRIVEN	RECOVERY	OVA teems	MOISTURE	DENSITY	COLOR	OAMPLE NUMBER	DEPTH IN FEET	Marchael and Marchael	LTR		
Z	7									3)	H		TD= 40.0'	
	TO,										H	j		
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				<u>. </u>										

NOTES:_ EDITED BY/DATE:_

DPII t	ING LOG	DIVISION	INSTALL	ATIOH 1111	······································	Hole No. AP-62 SHEET) OF 9 SHEE	
I. PROJECT			10. SIZE	AND TYPE	OF BIT	10'4 hit	
HKI (S)) LOCATION	(Coordinates	TUBY EAKER AFB AR.	- '' -	UM FOR EL	.EVATION	SHOWN (THM or MSL)	
. DRILLING	5' from	n LIF 62		E 750		SNATION OF DRILL	
USAC	C-CEIIR (An shown on	K-EP-66		AL NO. OF		DISTURBED UNDISTURBE	0
end file nu	ೄೄ ೧≀೯	PLORE AP-62		AL HUMBE		oxes	
ROGE	RILLER R HUN	TER		VATION OF			نـ <i>ا</i>
4. DIRECTIO	OF HOLE		IE. DAT	E HOLE		DET 95 18 OCT 95	
	AL CINCL			VATION TO			
7. THICKNES 8. DEPTH DA	LLED INTO					Y FOR BORING	_
. TOTAL DÈ	PTH OF HOL	E 10.7	7" K	ATURE OF ひまりりっ		18m	
ELEVATION	DEPTH LEG	CLASSIFICATION OF MATE (Description)	RIALS	RECOV- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water lass, depth a weathering, etc., if significant)	ł
	=					64"ID AUGER	
	3					Auger thru	
	\exists					Asialiali 4	
	<i>₁</i> ⊒					fill - No sample	
į	∄	SANDY, CLAY	24	1		1	
	==	600	,				
	\exists	41/ 91-42				SET UP REJECT	•
	2_=	dr. gray to				to 2311F From	1
	\exists	petroleum o	dor			3-25-95	
	=						
	=						
	3	ļ	3.0_	Į			.0
	∄	60.700.700	e /				
	4	SILTY LENN	LLAY			inserted INITER	
	∄ .	damp - moist				bbl sampler	
	4	mottled grey s	•			Ran 218	
	∄	Jrange V. Srire			4.2 65012CH	Rec 2.6	
	4	J h	,		FIELD ?	RPH 0.2 Sell out of	•
	\equiv	medium-to still petroleum odor	1 .	ļ	4.5	5/122	
	5_						
i	∃	+		İ			
		becomes sand	У				
	∄	only fine sand	vet			5.8	
	4=	pe Imleum adai Stiff	r (heavy)			Push probe 7.0"	
	∄		6.2_	-		Suger 5'	
	_=	SILTY CLAY to cla	yey silt			, Rec 4.9'	
	∃	V.STIFF TO S		Ks W/	pressur) NEC .4.9	
	7-3	Cohesive			1	made measurements	5
		gray & oras	ac brown	n	7.4	from ougered dept of 108'; one fer	
		1 (ak brown a	ete ushen	1	Som ple	of 10.8' one fer	1
	=	cut w/ Knife	- 100Kg 10 en 7.9	Smc/k	1.K. F	troleum product)	
	8	SILT		1	7.8	olf of measurem	e).
	▏∃	DAEK GRAY; WE	1 10			made from tip o	
	크	SATURATED, ME				probe;	
	🗒	CLAYSY, COHES Petto Tevas odor	v <i>E</i>	1	8.1	, i	
	9 📑	1 /			sample	10.0 on augor =	
		SILTY CLAY	\	-9.2	9.0	10.1 on probe	
				1			
		STIFF HOUST	et dan seka		9.5		
	111111	STIFF HOUST GRAY 4. Mange L I ron redules	<i>(フッ</i> ル)		9.5 Sample		

	DIVISIO	WI	INSTALL			Hele No.	AP-62
DRILLING LOG		RD		MPK			OF Z SHEETS
rmstrona	Stude	EAKER AFB		AND TYPE		SHOAN (1916 * NET	J
ALER AFB	or Station)		<u> </u>		A-12 A-2	MATION OF DRILL	
RILLING AGENCY				E 75			
ISACE -CE 14 P.1 DLE NO. (As about on of Sis reposes)	<u> </u>	-66 #•1		L NO. OF		DISTURBED N	UNDISTURBED
		AP-62		AL KUMBE			<u>:</u>
WE OF DAILLER	ER			VATION GF	SOUND WA	TER	
RECTION OF HOLE			16. DAT	E HOLE	147.0	OCT95	18 OCT 95
VERTICAL THE		DEG. FROM VERT.	17. ELE	VATION TO			
HICKNESS OF OVERS						Y FOR BORING	١.
EPTH DRILLED INTO OTAL DEPTH OF HOL				ATURE OF		Idea	
	SEND	CLASSIFICATION OF MATERIA (Description)		t CORE RECOV. ERY		2644	MKS
. DEPIN LE		(Deveription) d		ERY	NO.	(Drilling time, we weathering, etc.	, if elections
		SILTY CLAY	· · ·				
]		(continued)			10.5		
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=						Taped L	pole to
13				[10,3' af	ter augers
1.,,=				ł	İ	NOTE:	•
15-				1		UAW VAM I	E TO
3						adjust o	ill depths
=						UP 0.1	•
16-3						Samples	
=				1	-	4.2 -4.5 7.4 - 7.8 (TPH, TRPH
e =	- .	er en en en en en en en en en en en en en		• 100 c	P 17 .	8.7-9/01	PAH FIELD
1 =	-					9.5-9.91	DISPUTE PAH
17-3	1			·		10.6-10.	FIELD TRPH
'							
		4				N	r in hole
						2.0 O	cT; hole
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Hole No. AP-67

			•				Hole No.	1P-67	
		1	ÍŠÍON	INSTALL				SHEET / OF / SHEETS	
DRILLI	HG LUG	l	MRD	10. SIZE	PK HD TYPE	OF BIT			
ARMSTER)1)5- V	ALID.	STUCY	11. BATU	FOR EL	EVATION)S	HOWN (THE & MSL)	Sanple;	
LOCATION (Coordinat	a or Stat	ion	12 MANU	FACTURE	N:S DESIGN	NATION OF BRILL		
EAKER AFB					12. MANUFACTURERS DESIGNATION OF DRILL CME 750 / SCAPS				
CEMPK	- EP -	<u> </u>	4 11114	13. TOTAL NO. OF OVER- MISTURBED UNDISTURBED					
and lite make	OVE	RCORT	AP-67			CORE BO	<u></u>	•	
ROGER	HLLER	(TEV)	·				ER NOT ENCO	UNIER D	
DIRECTION				IS. DATE		LATAR	TED CO	OCT 95	
-VERTICA			DEG. FROM VERT.					7 00.7 13	
. THICKNESS	OF OVER	BURDEN				P OF HOL	FOR BORING		
. DEPTH DRI				19. SIGN	TURE OF	INSPECTO	OR .		
. TOTAL DEP	TH OF H	OLE	8,6	<u> </u>			ر بردگر <u>ا</u> REMAR		
ELEVATION	0EPTH	EGEND	CLASSIFICATION OF MATERIA (Description)	ALS	% CORE RECOV- ERY	SAMPLE NO.	(Drilling time, water weathering, etc.,	r iose, depth of If elenificant	
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	77			-	1	1			
	\exists		SANDY FILL				İ		
			fine sand domp t	10				2 %	
1	3		moist, loose			3.8		3,8	
	4		ton to black	ents at	base	3.9			
	=	ı	} wet ; some blk frage	" 4 Z	.	SALIRE	4.2		
	=		dark green gray		•	1	10:		
			moist	n đ		45	1		
	Ξ		7MED = 311	<u>4.8</u>	-[1	AUGE R	5.0	
	5_		SILTY CLAY			[·	I .		
	Ξ		gray + orange br	מיטם		5.3	REC	5.0	
	_=		stf to v, stf			SALIPIE			
			some G. sand			5.5	1.		
	6		moist .			SALIFIL	5.8		
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]	=	1	Lecornes grayer	•		6.8			
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j	=	}	Silty clay		1	10	measure		
[=	}	VISTIFF.				from b	0110 m	
	-	1	gray & wange	han is	1	1	UP		
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	8 =	1	with fine sand damp to moist		1		7		
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	=	1	A Samuel Elle	6.5	- -	8.3	-		
1	-	}	clayey silt		<u> </u>		J	aprel 68.6 -	
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l	9-	1	green gray in oust to wet	· //	1	1			
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							GUCOUNTE	red. Hole	
	10						encounter backfill Concrete	red. Hole	

AP-63 Hele Ne. MSTALLATION DRILLING LOG MILD 74F.K SHEETS 10. SIZE AND TYPE OF BIT 10 14 " QUICE SIT ARIASTROLIG VALIDATION - LAKET LEB OCATION (Coordinates or Station) 12. MANUFACTURER'S DESIGNATION OF DRILL CIME-750 /SCAPE & 6" inner bul . DRILLING AGENCY CEITRK-ET-66 13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN HOLE NO. (As shown a AP-63 AND OF DRILLER 14. TOTAL NUMBER CORE BOXES IS ELEVATION GROUND WATER NOT EI)COUNTERED ROGER HUNTER STARTED 18 NOT 95 16. DATE HOLE 18 OCT 95 TVERTICAL MINCLINED 17. ELEVATION TOP OF HOLE 7. THICKNESS OF OVERBURDEN 19. SIGNATURE OF INSPECTOR 18. TOTAL CORE RECOVERY FOR BORING . DEPTH DRILLED INTO ROCK 8.7 9. TOTAL DEPTH OF HOLE REMARKS
(Drilling time, mater lane, depth of meathering, etc., if algulicant) RECOV-RECOV-SAMPLE NO. CLASSIFICATION OF MATERIALS ELEVATION DEPTH LEGEND Auger to 3.8' SANDY FILL petroleum odor 3.8 STAPT W/TIP OF PROCE AT 2,77 (3.81) SILTY CLAY PUSH PROBE, AUGER 5.0 dr green gray to Rec 4,Z 50 MOIST - Wet 5.3 petroleum odor high angle sand layer avance at to, + bottom 5 -SILTY CLAY petroleum odor gray + orange brown throughout sample) STIFF - VSTIFF MOIST 6.7 4.0 + SANL 0.07 looks like 0,2/ blk at bottom blk may be flat pa hole niessured to 7.2 1 SAND 7.2 SILTY CLLY to Iron ho pules Grange brown a gray Moist, STIFF-VISTIFF 8.7; made _ 7.5 measure ments from bottom op 74 SAND 0.07 looks like 0.2'. block at bottom contact/ clayey silt 8.71 dk greenish gray Cohesive wet medium -soft E DH Probe 11.10 below sample some fine sand No Liquid III HOLE CO LID OF ULY, SECUT (.) at end of 20 OCT; hole backfilled w Concrete 10

PROJECT

FNG FORM 10 2/

Hale No. AD-1,3

201)6		MI'D	10. 512E	AND TYPE	E OF BIT	00 Z SHI 101/4" BIT 4 6" FAMER			
20116	1/411	a Constant of Alders	100						
	VALL	D STIDY - CAKER	TI. BATE	IN FOR EL	EVATION	SHOWN (TBM or MSL)			
41 F.	AP	ton) '	12. HAHL	FACTURE	ER'S DESIG	NATION OF DRILL			
MKK-EP-66					CME 750				
11 C 1 C 1 C 1 C 1 C 1 C 1 C 1 C 1 C 1				DEN SAMPI	LES TAKE	K .			
RILLER									
- 1107	<u>yter</u>	·				TED ICOMPLETED			
		DEG. FROM VER	T. 16. DAY	HOLE		OCT 15 20 18T	15		
OF OVE	ROURDEN	· · · · · · · · · · · · · · · · · · ·							
			IS. SIGN	ATURE OF	FINSPECT	OR			
PTH OF H	OLE	13,6		44771	10 ()()	L8 11/11			
DEPTH	LEGEND	CLASSIFICATION OF MAYER (Description)	RIALS	RECOV-	SAMPLE NO.	REMARKS (Drilling time, water lose, depth weethering, etc., if significant	iof .		
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		wet w/product		1			, E	;	
3		clayey, cohesive				6" split inver bu	' E	•	
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=	1	GREEN GRAY	•		8.6		E		
9-	1	COHESIVE, Some	f sand			ine black clay	F		
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i -	1	Black Streak Wadi	. ماسيم ر	اماد			,		
	AT LEGISTIC STREET OF HOLLER ALLED IN THE STREET OF HOLLER ALLED IN THE STREET OF HOLLER ALLED IN THE STREET OF TH	AFE AP. GENCY As shown on drawle and of OFFSE OF HOLE AL DINCLINED OF OVERBURDEN LLED INTO ROCK PTH OF HOLE 2 3 7 7.1. 7.5. 8	ALP APPOSED FOR STATE OF A SAND YELLOW STATE OF HOLE JED INTO ROCK PTH OF HOLE JED INTO ROCK PTH OF HOLE JED INTO ROCK PTH OF HOLE JED INTO ROCK THO HOLE JED INTO ROCK THO HOLE JED INTO ROCK PTH OF HOLE JED INTO ROCK THO HOLE JED INTO ROCK THO HOLE JED INTO ROCK THO HOLE JED INTO ROCK THO HOLE JED INTO ROCK THO HOLE JED INTO ROCK THO HOLE JED INTO ROCK THO HOLE JED INTO ROCK THO HOLE JED INTO ROCK THE HOLE JED INTO HOLE	SAND Wet W product fine sand fine was a sharp to the sand A the sand was a sharp to the sand A the sand was a sharp to the sand A the sand was a sand A the sand was a sand A the sand was a sand A the sand was a sand A the sand	AF AP BEY-ST CHE 75: A D-63 II. TOTAL MO. OF A A D-63 III. TOTAL HOLE III. TOTAL HOLE III. TOTAL HOLE III. TOTAL HOLE III. TOTAL HOLE III. TOTAL HOLE III. TOTAL HOLE III. TOTAL COM	SAND VENT OF NOLE SAND VENT OF SOLE LEGEND	Thock clay: Thock	The AP Signature of Scientific Property of S	

		7.5	,	IINSTAL	LATION			D-63	ו	
DRILL	ING LO		VISION MRT		PK			2 SHEETS		
PROJECT				10. \$126	AND TYPE		SHOWN (TOM at MEL)]	
LOCATION	(Consider	-	DATION STULY	''- "^'	UR POR EL					
EAKE DRILLING	K AFB	<u>, H</u>	R				NATION OF DRILL			
Cε	MRK	-EP	-66		AL NO. OF		OISTURBED U	NDISTURBED	-	
HOLE NO.	(As shown	FFSE	AD-63				<u> </u>		4	
NAME OF	BRILLER	·	.1		AL HUMBE				_	
KOGE	R HUM	VIEK.	<u>/</u>	_				LETEO	-	
VERTIC			DES. PROM VI	RT. 16. DAT	E HOLE	zo	OCT 95 20	0CT 95		
THICKNES	- OF OUT		· · · · · · · · · · · · · · · · · · ·	17. ELS	VATION TO	P OF HO	.c			
DEPTH DR							r FOR BORING	- 1	4	
TOTAL DE	PTH OF H	OLE	*****		2011	11/.	9°9. In			
LEVATION	DEPTH	LEGEN9	CLASSIFICATION OF MAT			SAMPLE NO.	REMARKS (Drilling time, water is weathering, etc., it e	oss, dopth of significant]	
	" -	- -	(AS ABOVE)		10.1	 -	Run 2		F	
	⇉		STIFF CLAY	الاسمعا			107, 2		F	
		-2	est = wet, Harry are	en & orav	de.0.6		RAN 5		E	
		Sand	SAND + SILTY		T		REC.5		E	
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į	Ⅎ	RUT CONTA ROWGHOUT	STIFF . V. STF.	ET	11.9		ered.		F	
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	\equiv	3 3	gray w/ora	octor	1				E	
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	=	GLAY VERT	Lion nodule	r (rwyll)	ı İ				F	
	\Box		FINE SAND-	SAT		1		13.6	F	
	=	1.	petrokumo		/				- F	
	=		turns green		Ί			B.O.H	E.	
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Hole No. AD-68

							Hale No.	AD-68	_
DRILL	ING LO		MIII	INSTALL	111 F			OF SHEET	.]
BEG ICCY			AHOI) EAKER AFB	10. SIZE	AND TYPE	OF BIT	10 14 "auger B	14-	7
LOCATION	(Coordina	stee or Sta	- GAC STATION				HATION OF DRILL		_
DELL LING	AGENCY			Ct	네돈 75	(N	64"ID HO	llou) Stems	_
HOLE NO.	an distal	13. TOTAL NO. OF OVER-					_		
and file ma	•	FrSE	T AD 68		L HUMBE				\Box
ROSER.				 			TER NOT ENG	-OUNTERED	4
VERT			DES. FROM VERT.	16. DATE	· · · · · · · · · · · · · · · · · · ·			20 OCT 95	4
THICKNES	S OF OVE	ROURDE			ATION TO				-
TOTAL DE			8.6	19. SIGH	COAL (POA	ORO LIAL		7
LEVATION		LEGEND	CLASSIFICATION OF MATERIA			BOX OR SAMPLE NO.	REMA	RKS	_
LEVATION	b PIN	c	(Description)		ERY	HO.	(Drilling time, wei weethering, etc.	, if significant)	
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	<u>⊿</u> _=	}	VETIEF TO STIFF	=, maist	T	ALLALY		-	E
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	=	}	brown & grayer (1)	ν'	ľ	AILLY			E
	5-] .		<u> </u>					E
	=	1	Gray + orange b	SILT					F
	<u>-</u>	3	medium moist w/wet sur	faces			S.S - 6.0 AL	IALYTICAL SAIT	(£ E
	=	-	white root hairs Crumbly structure		5.1	5.8	4		E
	6 -	1	.w/ fine sand			GEOTECH SALIFLE	6.0-6.s (?	,	F
	=	٠ ک.ه	SILT W/CL	AY		6.1			F
		,	some fine so medium we some itorista	174, ak	the, all	445:	1		E
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	' =	3	inclay	7.2		7.2			E
	=	1	green gray, sdy, med, to wet	moist.		GEOTEG	:	44	ιE
	=	‡	SiLT CLAVEY		1	7.0	7.5-8.0 AL	CHYTICKL SAM	F
	8-	7.9	TI STIFF, become	nach Indu nach	ኘ				E
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NG FOR			OUS EDITIONS ARE OBSOLETE.		PROJEC	,	or proper or part	LHO: E HO	ᅳᅳ

							Hele Ne.	AP-67
DO:	ING LO	Div	VISION MPE	INSTALL	ATION N	1 P. K	11919 1191	SHEET /
PROJECT	ING EC	-	1-11- 2-	10. SIZE	AND TYPE	OF BIT	104 auger br	F/(0" inner bbl
ArmsTe	ा।८ ड	TUCY	EAKER AID, AF.	TI. DAYL	IN FOR EL	HOLTAVA	SHOWN (TEM or MEL.	, , , , , , , , , , , , , , , , , , , ,
		tos ex 21a	(Mn)	12. MANG	FACTURE	N'S DESIG	NATION OF DRILL	
L DRILLING USAC	E-CE	MP K-1	EP-618.) / SC		UNDISTURBED
HOLE NO.	(As shown	en dem	PE AP-68			OVER- LES TAKE	<u> </u>	
L NAME OF	DRILLER	LUITT	שׁ			R CORE B		COUNTERED
L DIRECTIO	NOF HOL	E	r ·			BTA	ATED C	MPLETED
VERTI	-		DE4. FROM VERT.	16. DAT				9 0.7 95
. THICKNES	s of ove	RBURDE				P OF HOL	FOR BORING	•
. DEPTH DR	ILLED IN	TO ROCK				INSPECT		
. TOTAL DE	PTH OF H	OLE	101				REMA	DY4
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIA (December of the control	LIS	ERY	BOX OR SAMPLE HO.	(Defling time, well weathering, etc.	er loss, depth of , if significant)
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	l				1	1 1	No fluid in	
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	▏∄						hole kac	
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	ΙΞ		\	2.9			below sh	ce where
	3_=		SAND	× -7	ł		re moved	From
			DAMP, FILLS, GERY to be				hole.	
	l ∃		Fill	3,4		1	REC	
	\Box		SILTY BLAY	•	l.		REC	1.1
	Ⅰ.∃		STIFF, DAMP +	בוחמ ח	+	 		
	⁴		DAFY GRAY					
	=	اِ		4,2	.	1		
	-		CLAYEY SILT		i	1		!
	E		medium, colors	ii.e			. ta	pe to 4.8
	ا ہے ا		DARY GOLEN GE	A/]			5.01
	ヿ゙ヿ゙		SOFT TRAISTAINED	•	l	1		
	=		J WET .	5.5	1			
	日日		SILTY CLAY		ļ	5.8	INSETTED H	obi, tip
	Ⅰ. 〓		SOME SAILL]	FILL TX	p at 5.5	pushed
	4 🗇		V.STIFF MOIST			6.0	0 4 5.5, 614 Lip	Guicher
	1 3		LEGRAY + orange	brown		6.5	, ,	
	-3		SOME IRING STAL	1254 Line		6.5		about 0.3'
]		firm nodules				below sh	اهد
	7 -			7.0_			RE.C. 4	1.9
	=		CLY SILT			1		
	<u> </u>		W/ f. sand . enhance greeneh gazy >/ sam lian stall	e				
	=		ing STAIN ' MOIST, STIFF - V.SIL	 7.¥		-1.8	FIELL TEF	
	8 =		SILTY CLAY - CLY SI			'	Popl Cars	s. (1 5)
	" =		STIFF , HOIST .			4	4,0	
	3		gray w/ or orge b			1	1.2	
	-			7.5	1	8.5	(probe m	ay have
]		CLAYEY SILT	****		8.8	Slipped	when .
	9 =		cohesive, greenish :	1 dy	1		renoud	from hole)
	=							
	=		> becomes saturated, i	ひてんり ハブ	1	9.5	lape to	9.9
	=		ļ ·			FER	tope to	f i h
	10 =		В. О. Н		1	9.8	Prof. Car	
	1. 3				J	1.748		

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APPENDIX B - 1B

WELL INSTALLATION LOGS

BX SHOPPETTE

Source: Halliburton NUS 1992 and 1995.



FIELD WELL COMPLETION	N FORM	TWILDI	_	CHRISTY BOX
NAME: EAKER AFB	Ry Ci	HOPETTE		LOCKING STEEL COVER
.00	PROJECT			INCH DIAMETER
HUMBER: 31498	MANAGER:	CoV (y-		CASING
153	194:	<u>bfil</u>		
MAME: TWILD!	~	12/11/91		BOREHOLE
EDMPANY A.W. POC	77			D to 30 feet
I WU IPMENT! _ V.		ONILLERI		BENTONITE-CEMENT
MCH MO	DLLOW STEM AUGE	W ISARAZZA		SEAL OR
	TARY WASH	HOURS ORILLED:		B-SACK CEMENT-SAND SEAL
ALLONE OF WATER JEED DURING DRILLING:	NONE	GALLONS		tofeet
STHOD OF DECOMPANIES TO	ressure s			
			1 1 1 1 0	TOP OF CASING AT
SEE WELL	L DEVELTIPA	LENT PORM		ARCOM TUNORUM LEAFT
EVBLOPMENT:				64 INCH DIAMETER
EGAN DATE:	TIME:	/:		BOREHOLE O 20 leet
GEM FROM	TO	DATE:	J.60	W 2
TIME!		DATE		SCHEDULE 40 PVC
GPM FROM	το /	QATE:		BLANK CASING
GPM FROM	to /	UATE:). 2 to 15.21eer
GPM FROM	то	DATE:	• •	SENTONITE CEMENT SEAL OR
OTAL WATER REMOVED URING DEVELOPMENT:	7		i i ! • →□	8-SACK CEMENT-SAND SEAL
ESCRIPTION		GALLONS		
	\			
T END OF	_	LIGHTLY CLOUDY		1001
EVELOPMENT: MOD. TL		LIGHTLY CLOUDY /ERY MUDDY	5388 2339	BENTONITE PELLET SEAL
EVELOPMENT: MOD. TO				BENTONITE PELLET SEAL 12.5:0 11 'eet
MOD. TO	URBIO UV	PRY MUDDY		BENTONITE PELLET SEAL 12.5:0 / reet Coloranie Silica 24
DOR OF ATER: GROUND SU	RFACE TANK			BENTONITE PELLET SEAL 12.5:0 11 'een Digraps: Silica 2dy
MOD. TO MOD. T	RFACE TANK	TRUCK		BENTONITE PELLET SEAL 12.5:0 11 feet ULGRADE: SILICA 20/9 (PAME) SAND PACK 30:012.5 feet
DOR OF JATER GROUND SUITECHARGED GROUND SUITEC	RFACE TANK	TRUCK		BENTONITE PELLET SEAL 12.5:0 11 'set ULICATOR SILICA 2d SAND PACK 30 10 12.5 1001 2 INCH DIAMETER
DOR OF VATER: OTHER DEVELOPMENT: DOR OF VATER: D	RFACE TANK	TRUCK		BENTONITE PELLET SEAL 12.5:0 11 'eet DUERANG: SILICA 2d; SAND PACK 30:0 12.5:00: DINCH DIAMETER SLOTTED 1 0.006
DOOR OF VATER GROUND SU	IRFACE TANK	TRUCK AGE TANK ER		BENTONITE PELLET SEAL 12.5:0 11 'set CULCRAIDS SILICA 2d SAND PACK 30 10 12.5 feet 2 INCH DIAMETER SLOTTED 1 0.00 6 12:0 25.2 feet
DOR OF LATER GROUND SUITSCHARGED GROUND SUITSCHARGED GROUND SUITSCHARGED GROUND SUITSCHARGED GROUNG SEWITSCHARGED GROUNG SEWITSCHARGED GROUNG SUITSCHARGED GROUNG SUITSCHARGE GROUND SUI	IRFACE TANK	TRUCK AGE TANK ER		BENTONITE PELLET SEAL 12.5:0 'eet COLORAND: SILICA 20 SAND PACK 30:10 12.5 leet 2 INCH DIAMETER 5.2:0 25.2 leet 2 INCH DIAMETER
MOD. TO MOD. T	ADC SILICA	FEET 20/40 SAND		BENTONITE PELLET SEAL 12.5:0 11 'see DUCKANDS: SILICA 2d SAND PACK 30:012.5:see LINCH DIAMETER SLOTTED ! 0.006 DEN: SCREEN 5.2:025.2 iset 2 INCH DIAMETER SCHEDULE 40 PVC BLANK SILT TRAP
MOD. TO MOD. T	ADC SILICA	FEET 20/40 SAND		BENTONITE PELLET SEAL 12.5:0 11 'set ULGRAND: SILICA 2d SAND PACK 30:012.5!set LINCH DIAMETER SLOTTED ! 0.006 DEN: SCREEN 5.2:025.2 ieut 2 INCH DIAMETER SCHEDUIE 40006
DON OF ATERIALS USED 100-# SACKS OF LOLDRA SACKS OF GROUT	URBID V	FEET 20/40 SAND		BENTONITE PELLET SEAL 12.5:0 11 seet 12.5:0 11 seet 12.5:0 11 seet 10.662000 seet 20.10 12.5 seet 2 INCH DIAMETER SCOTTED 0.006 SCOTTED
DOR OF ATER: OTHER SENSED GROUND SUITECHARGED GROUND SUITECHARGED GROUND SUITECHARGED GROUND SUITECHARGED GROUND SUITECHARGED GROUND SUITECHARGED GROUND SACKS OF LOURGE GROUND	ADO SILICA	FEET 20/40 SAND		BENTONITE PELLET SEAL 12.5:0 11 seet 12.5:0 11 seet 12.5:0 11 seet 10.6000 formation 10.000
DON OF ATER GENERALS USED 1 DON'S SACKS OF LOLOR: SACKS OF LOLOR: SACKS OF POWDEREI 5 0 POUNDS OF BENTONI	URBID V	FEET 20/40 SAND CEMENT TYPE I W/BENTO BOY		GENTONITE PELLET SEAL 2.5:0 'eet 2.5:0 'eet 2.5:0 'eet 30:0 2.5 eet 30:0 2.5
DOR OF ATER: ATER: ATER: ATER: DISTORM SEW! DORUMS EPTH TO WATER FTER DEVELOPMENT: IATERIALS USED 100 SACKS OF LOUGH SACKS OF SACKS OF POWDERE! SACKS OF POWDERE! 50 POUNDS OF BENTON! 15 FEET OF 2 INCH!	ADO SILICA USED (ALTLANE D BENTONITE TE PELLETS PVC BLANK CASIN	FEET CONTO SAND CEMENT TYPE W BENTO DOLL		BENTONITE PELLET SEAL 2.5:0 'eet 2.5:0 'eet 2.5:0 'eet 30:0 2.5 3
DOR OF ATER: ATER: ATER: ATER: DISTORM SEW! DORUMS EPTH TO WATER FTER DEVELOPMENT: IATERIALS USED 100 SACKS OF LOUGH SACKS OF SACKS OF POWDERE! SACKS OF POWDERE! 50 POUNDS OF BENTON! 15 FEET OF 2 INCH!	ADO SILICA USED (ALTLANE D BENTONITE TE PELLETS PVC BLANK CASIN	FEET CONTO SAND CEMENT TYPE W BENTO DOLL		GENTONITE PELLET SEAL 2.5:0 'eet 2.5:0 'eet 2.5:0 'eet 30:0 2.5 eet 30:0 2.5
EVELOPMENT: MOD. TO PATER: ATER: ATER: OF OR OF ORDERS EPTH TO WATER FTER DEVELOPMENT: IATERIALS USED 100 SACKS OF LOUGE SACKS OF COUT SACKS OF POWDERED 50 POUNDS OF BENTONI 15 FEET OF LINCH F	ADO SILICA USED (PULTLAINE D BENTONITE TE PELLETS PVC BLANK CASIN	FEET ZO/YO SAND CEMENT TYPE I W/BENTO DITY		BENTONITE PELLET SEAL 2.5:0 'eet 2.5:0 'eet 2.5:0 'eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 eet 40:0 CLEANED OUT TO 30:0 fet
MOD. TO MOD. TO MOD. TO MOD. TO MATER: ATER GROUND SUIDENERS GROUND SUIDENERS	URBID V	FEET CEMENT TYPE T W/BENTO DITY FEEN		BENTONITE PELLET SEAL 2.5:0 'eet 2.5:0 'eet 2.5:0 'eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 2.5 eet 30:0 eet 40:0 CLEANED OUT TO 30:0 fet
MOD. TO MOD. TO MOD. TO MOD. TO MATER: ATER GROUND SUIDENERS GROUND SUIDENERS	URBID V	FEET CEMENT TYPE T W/BENTO DITY FEEN		BENTONITE PELLET SEAL 12.5:0 'eet 2.5:0 'eet 2.5:0 'eet 30.10 12.5 30.10 12.
MOD. TO MATER! SATER GENERALS USED 100-# SACKS OF LOUR! SACKS OF LOUR! SACKS OF POWDERE! 50 POUNDS OF BENTON! 15 FEET OF LINCH! YARD CEMENT-SANG	URBID UNBID	FEET CEMENT TYPE T W/BENTO DITY FEEN	ADDITIONAL INFOR	GENTONITE PELLET SEAL 2.5:0 'eet 2.5:0 'eet 2.5:0
MOD. TO MATER! MOD. TO MATER! MATERIALS USED IDOM SACKS OF LOUGH SACKS OF LOUGH SACKS OF POWDERED SACKS OF POWDERED THE OF LOUGH SACKS OF POWDERED THE OF LOUGH SACKS OF POWDERED SACKS OF POWDERED THE OF LOUGH YARD CEMENT-SANCE ONCRETE PUMPER USED?	URBID V	FEET CEMENT TYPE T W/BENTO DITY FEEN		GENTONITE PELLET SEAL 2.5:0 'eet 2.5:0 'eet 2.5:0
MOD. TO WATER: STORM SEWING DISCOMANGED GROUND SUITED GROUND SUITED GROUND SUITED GROUND SUITED GROUND SUITED GROUND SUITED GROUND SACKS OF LOUGH SACKS OF LOUGH SACKS OF POWDERED GROUNDS OF BENTONI SACKS OF POWDERED GROUNDS OF BENTONI SACKS OF POWDERED GROUNDS OF BENTONI SACKS OF POWDERED GROUNDS OF BENTONI SACKS OF POWDERED GROUNDS OF BENTONI SACKS OF POWDERED GROUNDS OF BENTONI SACKS OF POWDERED GROUNDS OF BENTONI GROUNDS OF	URBID VES	FEET CEMENT TYPE T W/BENTO DITY FEEN	AODITIONAL INFOR	BENTONITE PELLET SEAL 2.5:0 'eet 2.5:0 'eet 2.5:0
MOD. TO MATER! ATER! ATER! ATER! ATER DEVELOPMENT: DOTUMS EPTH TO WATER FTER DEVELOPMENT: IATERIALS USED ACKS OF COLORS SACKS OF COLORS SACKS OF POWDERE! SACKS OF POWDERE! TO POUNDS OF BENTON! 15 FEET OF INCH! THE COLORS THE COLORS ACKS OF POWDERE! THE COLORS ACKS OF POWDERE! THE COLORS ACKS OF POWDERE! THE COLORS ACKS OF POWDERE! THE COLORS	URBID VES	FEET CEMENT TYPE T W/BENTO DITY FEEN	AODITIONAL INFOR	GENTONITE PELLET SEAL [2.5:0] 'eet [2.5:0] 'eet [2.5:0] 'eet [2.5:0] 'eet [3.6:0] 'ee



FIELD WELL COMPLET	ION FORM		CHRISTY BOX			
HAME EAKER AFS	BX			LOCKING STEEL COVER		
NUMBER: 3K98		مرابع مرابع		STEEL CONDUCTOR CASING		
LOGGED USB	EDITED D	FIL				
WELL NAME: T:4// 0Z		DATE: /2-//-9/	 	INCH DIAMETER		
DRILLING A WPOOL		113		to feet		
	HOLLOW STEM AUGE	DRILLER:		BENTONITE CEMENT		
<u>/</u> _`	ROTARY WASH	HOURS DRILLED: 66		BSACK CEMENT SAND		
SALLONS OF WATER	NONE	GALLONS				
METHOD OF DECONTAMINATI			-	TOP OF CASING AT		
DEVELOPMENT SEE WE				SELOW GROUND LEVEL		
NETHOD OF DEVELOPMENT:				6 1/4 INCH DIAMETER		
DEVELOPMENT BEGAN DATE:	TIME:			BOREHOLE		
VIELD: TIME!		DATE:		- ZINCH DIAMETER		
GPM FROM	<u> </u>	DATE		SCHEDULE 40 PVC BLANK CASING		
GPM FROM	<u> </u>	DATE:		Q-/ 10 /2.4 feet		
GPM FROM	<u>to</u>	DATE:	+	SEAL OR		
GPM FROM	TO.	<u> </u>		BSACK CEMENT-SAND		
DURING DEVELOPMENT: DESCRIPTION		GALLONS		11 10~0.5 feet		
OF TURBIDITY CLE	<u> </u>	IGHTLY CLOUDY		BENTONITE PELLET		
ODOR OF	5, . O. O. O. O. O. O. O. O. O. O. O. O. O	ENT MODOT		9 :0 // feet		
WATER GROUNG	SURFACE TANK	TRUCK		SAND PACK		
TO: DSTORM S		AGE TANK		1/_10.37.7 feet		
DRUMS	DOTHE					
AFTER DEVELOPMENT		FEET		SLOTTED 1 0.06		
MATERIALS USED	•			12.4 :0 326 leet		
3.5 SACKS OF 5/2/	CA GRADE	SAND		SCHEDULE 40 PVC		
SACKS OF		CEMENT		BLANK SILT TRAP		
AZO GALLONS OF GRO	OUT USED (POSTLAND	TYPEI W/BENTON TE)		BOTTOM WELL CAP		
SACKS OF POWDS	ERED BENTONITE			<u>∂y Z</u> leet		
POUNDS OF BENT			-	HOLE CLEANED OUT TO		
12,4 FEET OF 2 IN				<u>30</u> 1981		
/67				ROTTOM OF BOREHOLE		
			NOT TO SCALE			
	SAND (REDI-MIX) USED		_	NFORMATION:		
CONCRETE PUMPER USED?	NO TES			esuedio to 2'		
WELL COVER USED: LOCK	ING STEEL COURS		Action to	costing and		
□ сня!	STY BOX					
□отне	R					



FIELD WELL COMPLETION	I FORM			CHAISTY SOX
NAME: EAKER AFB	BX			LOCKING STEEL COVER
NUMBER: 3K98		-V6-	41-1	INCH DIAMETER STEEL CONDUCTOR CASING
LOGGED JSB	EDITED B	FN		
WELL TWIIDS	1	DATE: 12 (1) 91		INCH DIAMETER
DRILLING AW POOL		1 1011111		
FOUNDAMENT: . ().	LLOW STEM AUGI	R V. BARAZZA		BENTONITE-CEMENT
	TARY WASH	HOURE		8-SACK CEMENT-SAND
GALLONS OF WATER)0 NE	GALLONS		tofeet
METHOD OF DECONTAMINATION PRIOR TO DRILLING	ressure str	SAM.		TOP OF CASING AT
DEVELOPMENT SEE WELL				FEET ABOVE AT SELOY GROUND LEVEL
METHOD OF DEVELOPMENT:				WY INCH DIAMETER
OÈVELOPMENT BEGAN DATE:	TIME			BOREHOLE O:0 30 leet
GPM FROM	TO	DATE:		INCH DIAMETER
TIME:	то /	DATE:	l i	SCHEDULE 40 PVC BLANK CASING
YIELD: TIME:	то	DATE:		0./ to 15./ feet
TIME:	то	DATE:		SEAL OR
TOTAL WATER REMOVED DURING DEVELOPMENT:	$\sqrt{}$	GALLONS		8-SACK CEMENT-SAND
DESCRIPTION OF TURBIDITY DELEAR		SLIGHTLY CLOUDY		BENTONITE PELLET
AT END OF DEVELOPMENT: MOD. T	URBID 🔲	VERY MUDDY		SEAL 1/3 1000
ODOR OF WATER:	· · · · · · · · · · · · · · · · · · ·			
WATER GROUND SU		K TRUCK		SAND PACK
TO: □STORM SEW □DRUMS	ERS □STO □ OTH	RAGE TANK		13 to 30 teer
DEPTH TO WATER AFTER DEVELOPMENT:	<u> </u>	FEET		SLOTTED 1 0-010
MATERIALS USED				STATE SCREEN
3.0		•		INCH DIAMETER
3.5 sacks of		SAND		SCHEDULE 40 PVC BLANK SILT TRAP
SACKS OF		CEMENT	11	25:1 10 27/ test
SACKS OF POWDERS			<u> </u>	BOTTOM WELL CAP
POUNDS OF BENTON				HOLE CLEANED OUT TO
		ING		30 1991
10 FEET OF 2 INCH	PVC SLOTTED SC	REEN		ROTTOM OF BOREHOLE
YARDI CEMENT-SAN	ID (REDI-MIX) US	ED -		NAL INFORMATION:
_	SAL DAES		WELL !	ABANDOISED 1/8/72
NAME	A 000000			<u> </u>
WELL COVER USED: LOCKIN	Y BOX			
□ OTHER				



FIELD WE	LL COMPLET	ON FORM			CHRISTY BOX
108					LOCKING STEEL COVE
HAME! EA	KER AFB			. ()	INCH DIAMETER
OB TUMBER:	3K9B	PROJECT MANAGER:	GYG		STEEL CONDUCTOR
Y:	BEN	EDITED SY:	BEN		
ME: TU			DATE: /Z -//- 9/		NCH DIAMETER
LLING PANY:	A.W. POOL				- to - leer
JIPMENT:	12 644 INCH	HOLLOW STEM AUGI	ER V. RAPB 2 2 A		BENTONITE CEMENT
	_	ROTARY WASH	HOURS		SEAL OR 8-SACK CEMENT-SAND
LONE OF			ORILLED:	1 8 1	SEAL .
	DECORTANHATIO		GALLONS	مسن م	10 1eer
	والمراجع المراجع المراجع المراجع المراجع المراجع المراجع المراجع المراجع المراجع المراجع المراجع المراجع المراجع	Pressure si			TOP OF CASING AT
THOO OF	ENI SEE DEV	ELLAMENT FOR	in		FEET ABOVE AT
YELOPMEN					6'14 INCH DIAMETER
SAN DATE	T	TIME:			40.101065
ELD:	PM FROM	TO	DATE:		0 :0 30 terr
LD.	PM FROM		DATE:		SCHEDULE 40 PVC
LD:	TIME	го	DATE:		BLANK CASING
LD:	PM FROM	TO.	IDATE:		SENTONITE CEMENT
	PM FROM	<u> </u>			SEAL OR SACK CEMENT-SAND
NING DEVE	LOPMENT		GALLONS		SEAL
SCRIPTION TURBIDITY END OF	CLEAF	. □s	LIGHTLY CLOUDY	333	10 .0 ~0.5 less
FLOPMEN	TÍ DMOD.	\ * '	ERY MUDDY		BENTONITE PELLET SEAL
P OF					10:012 'en
TER CHARGED	GROUND S	URFACE TANK	TRICK		COLCRADE SIUCA ZA/40
CHANGED	STORM SET		AGE TÄNK		SAND PACK
TH TO WAT	DRUMS	□отн∈			2 INCH DIAMETER
EN DEAEF	OPMENT:		FEET		SLOTTED 10.0/
TERIALS	USED				19/ 10 34/ feet
		/	•		
	ACKS OF <u>Silic</u>		SAND		SCHEDULE 40 PVC
S/	ALLOWS ST		CEMENT		BLANK SILT TRAP
G	ALLONS OF GROU	TUSED (PORTANI)	TYPE I WIGHTON	الح	BOTTOM WELL CAP
·	ACKS OF POWDER	ED BENTONITE			teet
	DUNDS OF BENTON			 	HOLE CLEANED OUT TO
		PVC BLANK CASIN		ļ	30 Int
		EVE SLOTTED SCRE	EN		BOTTOM OF BOREHOLE
		CREUDAIXI ORDE		NOTTESE	
		ID IREDI-MIXI USED	-		AL INFORMATION:
NCRETE PUI	MPER USED?	NO DYES		~=====================================	-cinconmetion:
ME		`		*	
FF CONEW O	SED: TOCKING	S STEEL COVER		-	
	☐ CHRISTY	BOX			



FIELD WELL COMPLETION	I FORM	☐ CHRISTY BOX
00	•	LOCKING STEEL COVER
IAME: EAKER AFR	PROJECT MANAGER: G VG	STEEL CONDUCTOR CASING
09950	GV G	
V: BFN	PATE:	INCH DIAMETER
AME: EITWOS	12/13/91	BOREHOLE
OMPANY: Pol	Drilling	
QUIPMENT: 649 INCH HO		BENTONITE CEMENT
	TARY WASH DRILLED: 4/6	8-SACK CEMENT-SAND
ALLONS OF WATER	ONICLES: 378	toleet
SED DURING DRILLING: NO.	ルモ GALLONS	
RIOR TO DRILLING:	cheaned	TOP OF CASING AT
EVELOPMENT SEE LOGB	COL; WELL CONTAINS PREE	GELON GROUND LEVEL
ETHOS OF PRODUCT	, was not belowed	6 14 INCH DIAMETER
EVELOPMENT	TIME:	BOREHOLE O 10 25 teet
TIME:	DATE:	
GPM FROM	TO DATE:	SCHEDULE 40 PVC
GPM FROM	10	BLANK CASING 2:3 to 13:1/2 feet
GPM FROM	TO DATE:	
GPM FROM	TO DATE:	SEAL OR
OTAL WATER REMOVED	GALLONS	8-SACK CEMENT-SAND
ESCRIPTION	X	9 .0 0.5 teet
T END OF CEVELOPMENT:	SLIGHTLY CLOUDY	BENTONITE PELLET SEAL
MOD. T	WESTO VERY MUDDY	9 :0 // 'eet
MATER:		CO-ORADE SILICA
WATER DISCHARGED DEFOUND SU		SAND PACK
TO: STORM SEW	STORAGE TANK	
DEPTH TO WATER		SLOTTED : 0-0/0
AFTER DEVELOPMENT:	FEET	men - SCREEN
MATERIALS USED		13.4 .0 23.4 inet
2.5 SACKS OF 5/4/6	A 60-10 20/40 SAND	2 INCH DIAMETER
	CEMENT	BLANK SUIT TRAP
	TUSED (PORTAND TYPE I CEMEN	23.4 to 25.5 leet
	Date to the second	BOLIOM WELL CAP
SACKS OF POWDER	ED BENTONITE /	25-Sieet
POUNDS OF BENTON		HOLE CLEANED OUT TO
	PVC BLANK CASING	
- 7. 7 - 2. 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1		
YARD3 CEMENT-SAN		NOT TO SCALE
YARD ³ CEMENT-SAI	ID (REDI-MIX) USED	ADDITIONAL INFORMATION:
]NO □YES	
NAME		
WELL COVER USED: NLOCKIN	G STEEL COVER	
Осняізт Потнея	Y BOX	



FIELD WELL COMPLETIO	N FORM		CHRISTY BOX
208 F			LOCKING STEEL COVER
NAME: EAKER APB			INCH DIAMETER
NUMBER: 3K98	PROJECT GEORGE GE	urtseff	STEEL CONDUCTOR CASING
LOGGED LRE	ST: BFN		tofeet
NAME: EILTWOG	DATE	15/91	BOREHOLE
OMPANY: , Pol	Drilling		to
EQUIPMENT: D 644 INCH H	OLLOW STEM AUGER V. FOR	razza	BENTONITE CEMENT
INCH R	TARY WASH HOURS	.1.2	8-SACK CEMENT-SAND
SALLONS OF WATER	CNE GALLONS	 	1ect
METHOD OF DECONTAMINATION PRIOR TO DRILLING:	HIGHPAESS WE STEA		TOP OF CASING AT
	. •	200	FEET ABOVE AT
METHOD OF DEVELOPMENT:			6 1/4 INCH DIAMETER
DEVELOPMENT			BOREHOLE
TIELD: TIME:	TIME:		<u> </u>
GPM FROM	TO DATE:		INCH DIAMETER SCHEDULE 40 PVC BLANK CASING
GPM FRQM	TO DATE:		-0.3 to 13,50 feet
GPM FROM	TO DATE:		BENTONITE CEMENT
GPM FROM	то		SEAL OR B-SACK CEMENT-SAND
TOTAL WATER REMOVED DURING DEVELOPMENT:	GALLONS		SEAL 11 .0~C. S leer
OF TURBIDITY DELEAR	SLIGHTLY C	LOUDY	BENTONITE PELLET
DEVELOPMENT: MOD.	TURBID VERY MUDO	<u>*</u>	SEAL . 9 :0 11 'eet
ODOR OF WATER:			COLORADE SILICA EN
OSCHARGED GROUNDS			SAND PACK
TO: STORM SE	NERS STORAGETANK	=	A INCH DIAMETER
DEPTH TO WATER AFTER DEVELOPMENT:	FEET		SLOTTED: , CCG
MATERIALS USED			19:00 SCREEN -13.50 TG 23.76 (ast
3.5 SACVE DE 8		· =	2 INCH DIAMETER
3ACA3 UF		SAND	SCHEDULE 40 PVC BLANK SILT TRAP
SACKS OF		CEMENT	43.79 to 25.70 leet
SACKS OF POWDER	IT USED (CEMENT / BENT	وجم رجع الح	BOTTOM WELL CAP
50 POUNDS OF BENTO			HOLE CLEANED OUT TO
13.20 FEET OF 2 INC			1981
-/0-m			
à.e⊂			Total Control of the Local Con
	NO INCOMINT ORDERED	NOT	TO SCALE
YARD3 CEMENT-SA	NO (REDI-MIX) USED	ADDI	TIONAL INFORMATION:
CONCRETE PUMPER USED?	NO CYES	·	
NAME			
WELL COVER USED: X LOCKIE	NG STEEL COVER		
DOTHER			



FIELD WELL COMPLETION FORM	CHRISTY BOX
90 Co	LOCKING STEEL COVER
IAME: EAKER AFB	- INCH DIAMETER
HUMBER: 3199 MANAGER: GV G	CASING
ivier the spires of the	10
WELL EITU 07 DATE: 12/13/91	BOREHOLE
DRILLING A.W. POOL	
EQUIPMENT: 1/4 ORILLER:	BENTONITE CEMENT
6/4 465 3/3//52 Mount	SEAL OR
INCH ROTARY WASH GRILLEDIO.75	II I I I SEAL .
ISED DURING DRILLING: NONE GALLONS	
PRESSURE STEAM	TOP OF CASING AT
DEVELOPMENT SEE DEVELOPMENT FORM	-0.15 FEET ABOVE AT BELOW GROUND LEVEL
METHOD OF DEVELOPMENT:	7 1/4 INCH DIAMETER
DEVELOPMENT	BOREHOLE O Socio
TIME: DATE	3
GPM FROM TO	SCHEDULE 40 PVC
GPM FROM TO	BLANK CASING
GPM FROM TO	SENTONITE-CEMENT
GPM FROM TO	SEAL OR SEAL OR SEAL OR
TOTAL WATER REMOVED GALLONS	SEAL SEAL
DESCRIPTION	feer `
AT END OF	BENTONITE PELLET SEAL
ODOR OF	11:013 1001
WATER:	Cowand Porto
WATER OBSERVANGED GROUND SURFACE TANK TRUCK TO: OSTORM SEWERS OSTORAGE TANK	SAND PACK
ORUMS OTHER	2 INCH DIAMETER
DEPTH TO WATER AFTER DEVELOPMENT: FEET	SLOTTED (0.00 C
MATERIALS USED	-15.07 to 25.15teet
	2 INCH DIAMETER
21/2 SACKS OF COLO. SI UCA 20/40 SANO	SCHEDULE 40 PVC BLANK SILT TRAP
SACKS OFCEMENT	35.15 in 37.15 test
GALLONS OF GROUT USED	SOTTOM WELL CAP
SACKS OF POWDERED SENTONITE	-37.15 teet
50 POUNDS OF BENTONITE PELLETS	HOLE CLEANED OUT TO
14.92 FEET OF 2 INCH PVC BLANK CASING	30 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
H-4254 FEET OF 2 INCHPYC SLOTTED SCREEN	BOTTOM OF BOREHOLE
2.00 TEL	
YARO3 CEMENT-SANO (REOT-MIX) ORDERED	NOT-TO SCALE
YARDI CEMENT-SAND (REDI-MIX) USED	ADDITIONAL INFORMATION
CONCRETE PUMPER USED? ZINO TYES	WET CONT
NAME	WELL ARAHOCNED 1/8/92
WELL COVER USED: CLOCKING STEEL COVER	
OTHER	



FIELD WELL CO	MPLETION FORM	4		CHRISTY BOX
MANEL EAKER	L. AFB		П	LOCKING STEEL COVER
HUMBER: 3K91	PRO#	istai Gug	╵	INCH DIAMETER STEEL CONDUCTOR CASING
LOGGED URE	EDITE	BEN		tofeet
WELL EUTWIL	08	DATE: 14/91		- INCH DIAMETER
5544 1 1 1 2 2	. Poor	12114(11		BOREHOLE
COUIPMENT:	4= 6214 6/4	EM AUGER V. BARRAZZE	.	SENTONITE CEMENT
<u></u>				SEAL OR SACK CEMENT-SAND
GALLONS OF WATER	INCH ROTARY WA	ORILLED: 0,75		SEAL .
USED DURING ORILL		GALLONS		
PRIOR TO DRILLING	, STEAN			TOP OF CASING AT
DEVELOPMENT &	SEE MET PENEL	CPMENT TOKA		SELOW GROUND LEVEL
DEVEDOPMENT:				BOREHOLE
DEVELOPMENT	TIME:			0 :0 29 leer
GPM FI	ROM TO	DATE	+	2 INCH DIAMETER
GPM F	MEN ROM TO	DATE:		BLANK CASING
	ROM TO	DATE:		0,2 to 8,20 feet
	ROM FO	DATE:	•	SEAL OR
TOTAL WATER REMO	OVED	GALLONS		B-SACK CEMENT-SAND
DESCRIPTION OF TURSIDITY	CICLEAR	SLIGHTLY CLOUDY	0.00	
AT END OF DEVELOPMENT:	MOD. TURBID	VERY MUDDY		BENTONITE PELLET SEAL
COOR OF				- 4:0 6 'em Core. Sinen 20/40
	GROUND SURFACE	TANK TRUCK		SAND PACK
, to:	STORM SEWERS	STORAGE TANK		6 10 25 1001
DEPTH TO WATER	DRUMS	OTHER		a INCH DIAMETER
AFTER DEVELOPMEN		FEET		SLOTTED (.OOC
MATERIALS USED				8.20 to 2320 feet
SACKS (of Silica George	SAND		SCHEDULE 40 PVC
SACKS (OF	CEM ENT		BLANK SILT TRAP
GALLON	S OF GROUT USED			BOTTOM WELL CAP
SACKS (OF FOWDERED BENTO	NITE		25.20 test
_	OF BENTONITE PELL			HOLE CLEANED OUT TO
	F_2 INCH PVC BLA			25 m
FEET OF	NCH PVO SLOT	TEO-SCREEN-		BOTTOM OF BOREHOLE
YARO	. 100		NOT TO SCA	
	CEMENT-SAND TREDIT	_	ADDITIONA	L INFORMATION: _Well
CONCRETE PUMPER	USED? MO 🗆	YES	Material	s polled on 12-18-91
	DECOCKING STEEL	2010	Full	ecovery on well
	CHRISTY BOX		5c rec	n E RISER Borehole
	Потнея		buck f	Hed will 250 sal
		•	•	,



]

field well completion (FORM		☐ CHRISTY SOX
100 EANCA 1. T.			LOCKING STEEL COVER
NAME: EAKER AFB	PROJECT C		STEEL CONDUCTOR
NUMBER: 3598	MANAGER: GUG		CASING
ev. LICE	BFN		
NAME: EIITWILO9	12/	14/91	BOREHOLE
COMPANY A.W. POOL			
EQUIPMENT: BY4 INCH HOLL	OW STEM AUGER V. C	er: Arrazzo	BENTONITE CEMENT SEAL OR
II INCH ROTA	RY WASH DRILL	50,50	SEAL CEMENT-SAND
GALLONS OF WATER		BIN	
MATHOR OF DECOMPOSITION (1614 PRESSURE STE		TOP OF CASING AT
	DEVELOPMEN'T		GELOW GROUND LEVEL
METHOD OF DEVELOPMENT:			674 INCH. DIAMETER
GEVELOPMENT BEGAN DATE:	TIME		BOREHOLE D 10 25 feet
YIELD: TIME:	DATE		2 INCH DIAMETER
YIELD: TIME:	OATE:	···	SCHEDULE 40 PVC BLANK CASING
YIELD: TIME:	OATE:		-0.2 to 8.20 feet
GPM FROM 1	DATE:		SENTONITE-CEMENT
GPM FROM T	o l		SEAL OR SSACK CEMENT-SAND
OURING DEVELOPMENT:	GALLO	NS	SEAL
OF TURBIDITY CLEAR AT END OF	☐\$LIGHTLY	CLOUDY	BENTONITE PELLET
GEVELOPMENT: MOD. TUR	810 VERY MUI)DY	SEAL C
GGGR OF WATER:			ODLORADO SILICA OSTO
DISCHARGED GROUND SURF	and the same tribute		SAND PACK
TO: STORM SEWER	STORAGE TAN	iK .	2 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
DEPTH TO WATER			SLOTTED 1-006
MATERIALS USED	FEET		inch + SCREEN
	· · · · · · · · · · · · · · · · · · ·		8.20 to 18.35test
2.5 SACKS OF COLON	ADOSIUCA 30/40	SAND	SCHEDULE 40 PVC
SACKS OF		CEMENT	BLANK SILT TRAP
GALLONS OF GROUT U	SED		BOTTOM WELL CAP
SACKS OF POWDERED	BENTONITE		20.>cleet
	e rellets		HOLE CLEANED OUT TO
8.00 FEET OF 2 INCH P			22 144
10.00 FEET OF 2 INCH PY	C SLOTTED SCREEN		SOTTOM OF BOREHOLE
200 Feet and			
YARD CEMENT-SAND	HEDIMIXI OMDERED		NOT TO SCALE
YARD ³ CEMENT-SAND		·	ADDITIONAL INFORMATION:
CONCRETE PUMPER USED?	O QYES		BureHule cured in 31
NAME			
WELL COVER USED: STLOCKING S OCHRISTY B OTHER			



FIELD WELL COMPLET	ION FORM				CHRISTY BOX
100			n n		Z LOCKING STEEL COVER
AME: FAICEN.	PROJECT /		<u> </u>	H	STEEL CONDUCTOR
UMBER: SKAB	MANAGER:	} VG	<u>.</u>		CASING
URE	BF	<u>N</u>			
EIITWILLO		DATE: 12/14/71			BOREHOLE
MPANY: AW POD	L				
UIPMENT: 12-614 INCL	I HOLLOW STEM AUGER	STILLER!	. 11	-	- BENTONITE CEMENT
_	I ROTARY WASH	HOURS	`	-	SEAL OR —[] 8-SACK CEMENT-SAND
LLONS OF WATER		ORILLED: 55	11	1 1 1	SEAL .
ED DURING DRILLING: THOO OF DECONTAMINAT	None	GALLONS			·
IOR TO DRILLING:	HIGH PRESSW	ie steam	, '		TOP OF CASING AT
	iel developine	UT FORM			FEET ABOVE AT BELOW GROUND LEVEL
LYMOD OF EVELOPMENT:					644 INCH DIAMETER
VELOPMENT	TIME:		·	-	BOREHOLE O to 25 leet
ELD: TIME:		DATE:	1		
tuoi Tingsi	TO	DATE	1		SCHEDULE 40 PVC
GPM FROM	<u> 10</u>	DATE:			8LANK CASING -0. 20, -8.20 feet
GPM FROM					BENTONITE-CEMENT
GPM FROM	70	DAYE.			SEAL OR SEAL OR SEAL OR
AL WATER REMOVED RING DEVELOPMENT:		GALLONS			CEA!
CRIPTION TURBIDITY CLE	AR TISL	IGHTLY CLOUDY	200	3333	<u>प</u> .o <u>~0.5</u> feet
THO OF		RY MUDDY			BENTONITE PELLET
R OF			<u> </u>		14 :0 6 'est
ER DOROUNG	SURFACE TANK			┡═	CLDAGOSKICA SOLVO
STORM :		GE TANK	j		SAND PACK
DRUMS	OTHER				- INCH DIAMETER
PTH TO WATER TER DEVELOPMENT:		FEET			SLOTTED 1 . 00 6
TERIALS USED				=	-8.30 :0-18.30 feet
3.5		4			- INCH DIAMETER
2.5 SACKS OF		_ _			SCHEDULE 40 PVC BLANK SILT TRAP
SACKS OF					18.30 -30.39
S GALLONS OF GR		TYBENTON FE) ,	┖╼┶╼┼	SOTTOM WELL CAP
SACKS OF POWD	EAED BENTONITE	·		1	leen
50 POUNDS OF BEN	TONITE PELLETS		-	 	HOLE CLEANED OUT TO
8.00 FEET OF 2 11	ICH PVC BLANK CASING	3			22-1711
10.00 FEET OF 2 IN	ICH PVC SLOTTED SCRE	EN			SOTTOM OF BOREHOLS
The second second				.	10.00
YARO CEMENT			NO.	TO SCALE	
YARO CEMENT			AD	DITIONAL	INFORMATION:
	DNO DYES				
AME			_		
ELL COVER USED: SLOCE	CING STEEL COVER				
⊔сняі □отні	STY BOX				



FIELD WELL COMPLETI	ON FORM				CHRISTY BOX
IOS TAYED AFR					- INCH DIAMETER
NAME: EAKER AFB	PROJECT MANAGER: G	V 6	41-		STEEL CONDUCTOR
UMBER: 3598	EDITED (
BFAI	64: 7	Inave.		 -	- INCH DIAMETER
AME: EIITWIII		12-15-91			BOREHOLE
OMPANY: POOL					BENTONITE-CEMENT
QUIPMENT: DE LE INCH	HOLLOW STEM AUGE				SEAL OR 8-SACK CEMENT-SAND
INCH	ROTARY WASH	DRILLED: ,42	11	1 11	SEAL .
ALLONS OF WATER	الاستان ال	GALLONS			10 1001
HETHOD OF DECONTAMINATION HIGH	on pressure	STEAM	1		TOP OF CASING AT
	JELL DEVELOP				FEET ABOVE AT
METHOD OF			`	-	- 6 1/4 INCH DIAMETER
DEVELOPMENT:			1	+	BOREHOLE
SEGAN DATE:	TIME:	DATE:			_ ZINCH DIAMETE
GPM FROM	то.	OATE:			SCHEDULE 40 PVC BLANK CASING
GPM FROM	το	DATE:			0 · / to 8 · / feet
GPM FROM	то /	PATE		!++	BENTONITE-CEMENT
GPM FROM		BATE!			SEAL OR BSACK CEMENT-SAN
TOTAL WATER REMOVED DURING DEVELOPMENT:	$\overline{}$	GALLONS		1 1 1	SEAL 5.5 10 ~0.5 feet
OSSCRIPTION CLE	AA □S	LIGHTLY CLOUDY			BENTONITE PELLET
AT END OF	O, TURSIO 📋 V	VERY MUDDY			SEAL 5.5 10 6.5 1000
000R OF		•		1 11	Crucanos Silica
WATER GROUN	D SURFACE TAN	K TRUCK	•	==:	SAND PACK
TO: USTORM		RAGE TANK			6.5 to 3-2 tees
DRUMS	□отн		•		
DEPTH TO WATER AFTER DEVELOPMENT:		FEET		=	non SCREEN
MATERIALS USED		·	-		~
3.5 SACKS OF	lica Grade	SAND			SCHEDULE 40 PVC
SACKS OF		CEMENT	r		BLANK SILT TRAP
	ROUT USED (EME	NT /KENTONITE	E MIX)		BOTTOM WELL CAP
	DERED BENTONITE	/ =			20./ tem
25 POUNDS OF BEN	ITONITE PELLETS		-		HOLE CLEANED OUT
8 FEET OF 3	NCH PVC BLANK CAS	ING			22 1901
10 FEET OF Z	NCH PYC SLOTTED SC	REEN	. 1.		← BOTTOM OF BOREH
	FORMER OR	DERED	N	OT TO SCAL	£ -
	LANG MESTARKEDS	ED .		ODITIONAL	INFORMATION:
CONCRETE PUMPER USED?	NO TYES		_		
NAME			- _		
WELL COVER USED: 200	CXING STEEL COVER		_		
			_		



FIELD WELL COMPLET	D WELL COMPLETION FORM		CHRISTY BOX	
108			П	LOCKING STEEL COVER
NAME: EAKER AFB	PROJECT	VG	4	STEEL CONDUCTOR
IUMBER: 3KYE		· · · · · · · · · · · · · · · · · · ·		
SELL BELL	SALLED -	DATE		INCH DIAMETER
AME: EITTUITZ		12-15-91		BOREHOLE
MILLING POUL DINK	12			
	HOLLOW STEM AUGER	V. Buya 234		BENTONITE-CEMENT SEAL OR
-	I ROTARY WASH	HOURS 1,25		8-SACK CEMENT-SAND
ALLONS OF WATER				tofeet
SED BURING DRILLING: STHOD OF DECONTAMINAT	<u> </u>	GALLONS	(21100) -(TOP OF CASING AT
RIOR TO DRILLING:	Steam cleaned		1 1 1	FEET ABOVE AT
	EL DEVELOPME	NT FORM		SELON GROUND LEVE
EXELOPMENT:				BOREHOLE
DEVELOPMENT DEGAN BATEI	TIME			0 :0 25 teen
TIME	TO	DATE		INCH DIAMETER
GPM FROM	то	DATE:		SCHEDULE 40 PVC BLANK CASING
IELD: TIME		DATE		0./ to 0./ feet
GPM FROM	ΤΟ /	DATE:	-	SEAL OR
GPM FROM	то		-	8-SACK CEMENT-SAND
OTAL WATER REMOVED URING DEVELOPMENT:		GALLONS		
CESCRIPTION CLE	AR 🖯 🔃 🗆 SL	IGHTLY CLOUDY		BENTONITE PELLET
T END OF DEVELOPMENT: MO	o. TURBIO 📄 🔲 V	ERY MUDDY		SEAL 5 :0 6:5 'en
DOR OF		· .		COLORADE SICICA ZULA
YATER /DIGROUM	D SURFACE TANK	TRUCK		SAND PACK
STORM	-	AGE TANK	=:	#-510 25./ teet
□ DRUMS	Оотне	R		INCH DIAMETE
DEPTH TO WATER		FEET		SLOTTED 1_0-006
MATERIALS USED			=	8.1 :0 23.1 ites
		•		- PINCH DIAMETE
<u> 3.6</u> SACKS OF <u></u>	145-4 GRAPE	SAND		SCHEDULE 40 PVC BLANK SILT TRAP
SACKS OF		CEMENT		23./ to 25./ leet
GALLONS OF GR	ROUT USED			SOTTOM WELL CAP
SACKS OF POWO	DERED BENTONLTE.		en	<u>35./</u> teet
75 POUNDS OF BEN	ITONITE PELLETS			HOLE CLEANED OUT
_	NCH PVC BLANK CASIN	IG		<u> 35-/</u> feet
_	NCH PVC SLOTTED SCR			SOTTOM OF BOREHO
		<i>4</i> "W.S.		
YARD CEMENT	SAND (REDI-MIX) ORD	EREO	NOTATORE	LE".
. -	-SAND (REDI-MIXTUSE		ADDITIONA	CINFORMATION:
CONCRETE PUMPER USED?	• •		Materia	al was pulled:
NAME		<u></u>	Groutel	to Surface, on 1216
WELL COVER USED: ALOO	KING STEEL COVER		27.007.5	covery afuell scree
Сня	RISTY BOX			/
LIOTH	(ER		& RISC.	<u> </u>



FIELD WELL C	OMPLETION FOR	M				CHRISTY BOX
100 FAK	ER AFB			П		LOCKING STEEL COVER
NAME: ENE		AGER: C	sVG-	41-	Π	STEEL CONDUCTOR CASING
LOGGED LRE	EDIT	TO B	PN			to
	ιτωιισ		DATE: 12/15/91	11	1 1 1	- INCH DIAMETER
	WPOOL		1 12 13 11			BOREHOLE
<u>-</u>	·		DRILLERI			BENTONITE CEMENT
Na F	INCH HOLLOWS		HOURS			SEAL OR 8-SACK CEMENT-SAND
GALLONS OF WATE	INCH ROTARY W		OUITED!	18	1 1 1	SEAL
METHOD OF SCO	MT AMAN A TION		GALLONS .			
PRIOR TO DRILLIA	16: 1+16		suee steam	` 1		TOP OF CASING AT
\ 	SEE WELL	EVELOP	MENT FOR	M		BELOW GROUND LEVEL
PEVELOPMENT:					1 1 1	BOREHOLE
DEVELOPMENT BEEAN DATE:	TIM	t:		1		C to 27 1000
TIELD: GPM	TIME: FROM TO		DAZE:		-	Z INCH DIAMETER
TIELD: GPM	TIME: FROM TO		DATE		1. 1.1	SCHEDULE 40 PVC BLANK CASING
VIELD: GPM	TIME: FROM TO		DATE:	1	1 11	0.15 to 335 feet
YIELDI	TIME:		DATE:		•	Bentonite-Cement Seal or
TOTAL WATER RE			GALLONS		7	8-SACK CEMENT-SAND SEAL
DESCRIPTION	DCLEAR				CS 2537	feer
OF TURBIDITY AT END OF DEVELOPMENT:	MOD. TURBID		IGHTLY CLOUDY			BENTONITE PELLET
2008 OF	/ CI MOD. TORSIO		ERT MODUT	<u> </u>	S SS	<u>6:04</u> 1000
WATER:	GROUND SURFACE	☐ TANK		ļ	!	(mane) (mane)
DISCHARGED TO:	STORM SEWERS	= ' '	AGE TANK	ì		SAND PACK
	☐ ORUMS	OTHE	Я			1NCH DIAMETER
AFTER DEVELOPE	(ENT:		FEET	i		SLOTTED (0.006
MATERIALS US	ED					8.35 :0 23.25 ites
3. sacu	S OF COLORADO	20/40	SAND		-	2 INCH DIAMETER
	s of		CEMENT	1		BLANK SILT TRAP
	ONS OF GROUT USED					
	S OF POWDERED BEN	CONITE				BOTTOM WELL CAP
	IOS OF BENTONITE PEI			<u> </u>		HOLE CLEANED OUT T
	OF_Z_INCH PVC BL		G			25.25 face
14.9	OF TIMES TWO SE			<u>L</u>		- BOTTOM OF BOREHOL
	41 500 500 500 500 500 500 500 500 500 50			. *		THE PARTY OF THE P
	LEWING TO THE REAL PROPERTY.	MIXI ORDI	ERED	· N	OT TO SCA	LE .
YAR	O' CEMENT-SAND (RED	I-MIXI USEC	5		ANOITIGO	LINFORMATION:
CONCRETE PUMP	ER USED?	□YES				s pulled; well
NAME				_	grew ted	to the surface
WELL COVER USE	ED: Z LOCKING STEE CHRISTY BOX OTHER		だ 色とし のうとい 至れのし	(31/42)		191 758



FIELD WELL COMPLETION	N FORM		CHRISTY SOX
NAME: EAKER AFB			LOCKING STEEL COVER
108 HUMBER: 3K98	PROJECT GVG		STEEL CONDUCTOR
LOGGED URE	EDITED BF		CASING
WELL EITWILL	15/	12/16/91	- INCH DIAMETER
COMPANY A. W POOL		12116171	BOREHOLE
——————————————————————————————————————	LLOW STEM AUGER	DRILLER! NAVAZA	BENTONITE-CEMENT
_	TARY WASH	HOURS .	SEAL OR SEAL O
SALLONS OF WATER	* . \ = 5	ORILLED:	11 SEAL
METHOD OF DECONTAMINATION	-	GALLONS	
	EAM CICANED		TOP OF CASING AT
DEVELOPMENT SEE WELL	NEVELDEM ENT	FORM	BELOW GROUND LEVEL
DENELOPMENT: DENELOPMENT DEGAN DATE:			GIV INCH DIAMETER
TIME!	TIME	DATE	<u>0 :0 24 1001</u>
GPM FROM	то	DATE	SCHEDULE 40 PVC
GPM FROM	то		BLANK CASING -D. 106.2
GPM FROM	то	DATE	SENTONITE-CEMENT
GPM FROM	70	OATE:	SEAL OR 8-SACK CEMENT-SAND
OTAL WATER REMOVED URING DEVELOPMENT:		SALLONS	SEAL 2 - C.S
SECRIPTION CLEAR	× □SLI	SHTLY CLOUDY	tofeet
PEVELOPMENT: MOD TU	RBID VEF	RY MUDDY	SEAL #
DOOR OF VATER:			Colorado 20/40
GROUND SUR		V	SAND PACK
DRUMS	RS STORAG	E TANK	1 - 4 10 18 1001
EPTH TO-WATER FTER-DEVELOPMENT:		EET	SLOTTED 1 0.006
ATERIALS USED			inch SCREEN G. 2 1064 test
2 SACKS OF Colora	1. Silve 20%		2 INCH DIAMETER
SACKS OF	W OTHER T		SCHEDULE 40 PVC
~ 2 GALLONS OF GROUT	MED (CENTER)	CEMENT	[일본 [8년] 17년 18년
SACKS OF POWDERED	BENTONITE	PEUG	ST. CON WELL CAP
0 POUNDS OF BENTONIT	_	SEA	
6.1 FEET OF 2 INCH P			HOLE CLEANED OUT TO
FEET OF 2 INCH P	C SLOTTED SCREE	۷ <u></u>	BOTTOM OF BOREHOLE
724			
YARO CEMENT-SAND	(REDI-MIX) ORDER	0	NOTE CONTOUR TO A PROPERTY OF THE PROPERTY OF
YARD ³ CEMENT-SAND		·×	ADDITIONAL INFORMATION
ONCRETE PUMPER USED?	O TYES		S EAL From 18-22'
VELL COVER USER. ON COMMON			
VELL COVER USED: DELOCKING S	STEEL COVER		
□отнея			



FIELD WELL COMPLETIC	N FORM			
108				CHRISTY SOX
MAME: EAKER AFR				LOCKING STEEL COVER
NUMBER: 31C98	PROJECT GUG		-	STEEL CONDUCTOR
LOGGED URE	EDITED BEN			CASING
MAME EUTWIUS	DATE	4440		INCH DIAMETER
COMPANY A.W. POOL	121	16/91		SOREHOLE
	ORILL			feet
II INCH H	DELOW STEM AUGER V.	ARRAZA		BENTONITE-CEMENT
ALLONG DE WALLE	TARY WASH PRILL	to: 1.0		- 8 SACK CEMENT-SAND SEAL
SED DURING DRILLING: A	عدد GALLOI	is		10feet
HIGH TO DRILLING:	HIGH BUELLINGE TE	AM.		TOP OF CASING AT
	TOPMENT FORM			-0.1 FEET ABOVE AT
ETHOD OF EXELOPMENT:				SECOMONO LEVEL
PEVELOPMENT PEGAN PATE:	TIME:			BOREHOLE
GPM FROM	TO DATE:			to to leet
GPM FROM	OATE:			SCHEDULE 40 PVC
ELD: TIME:	TO DATE:			BLANK CASING
GPM FROM	TO PATE:			SENTONITE-CEMENT
TAL WATER REMOVED	70			SEAL OR SEACK CEMENTSAND
RING DEVELOPMENT:	GALLON	<u>IS</u>		SEAL
TURBIDITY DELEAR	SLIGHTLY	CLOUDY		10er
MOD. T	URBID VERY MUD	DY		SEAL X
OR OF TER:				2 :0 4 'eet
CHARGED GROUND SU				COLORADO SILICA DOLLO MANO PACK
STORM SEW		•		4 10 18 1001
PTH TO WATER TER DEVELOPMENT:	OTHER			- a INCH DIAMETER
ATERIALS USED	FEET			SLOTTED (0.00 C
	·	 -		6.2 to 16.3 iees
	poo Sinca ograo	SAND	-	- DINCH DIAMETER
SACKS OF		CEMENT		BLANK SILT TRAP
2 GALLONS OF GROUT	USED (LEMENT/BEN	(عر . سور		
SACKS OF POWDERE				- BOTTOM WELL CAP
6.15 POUNDS OF BENTON	TE PELLETS	<u> -</u>		HOLE CLEANED OUT TO
LEE! OF THE INCH	PVC BLANK CASING			21 1781
10.1 FEET OF 2 INCH!	VC SLOTTED SCREEN			- BOTTOM OF BOREHOLE
		distance of the second		
YARD' CEMENT-SANG	(REDI-MIX) ORDERED			The Control of the Co
YARO ³ CEMENT-SANG	(REDI-MIX) USED	AD	DITIONAL INFO	PMATION:
ONCRETE PUMPER USED?	NO DAE2			8-21 TO JEAL
			off Lower	- WATER ZONE
ELL COVER USED: 区LOCKING □CHRISTY	BOX			
OTHER_				



198	A LOCKING STEEL COVE
MAME: ! EAKEK AIB	TINCH DIAMETER
NUMBER: 3K98 MANAGER: GUG	CASING
LRE SPITED BEN	to
MAME: EHTWIGS TWILL 12/14/91	BOREHOLE
ORILLING COMPANY:	
EQUIPMENT: WILLERS INCH HOLLOW STEM AUGER V.B. CA. 3.C.	BENTONITE CEMENT
INCH ROTARY WASH DRILLEDI O.S	BSACK CEMENT SAND
CALLONS OF WATER USED DURING ONILLING: GALLONS	
METHOD OF DECONTAMINATION PRIOR TO DRILLING: 1+EGH PRESSURE STEAM	TOP OF CASING AT
DEVELOPMENT	GELOWGROUND LEVE
METHOD OF DEVELOPMENT:	GELLITORIOND CEVE
DEVELOPMENT BEGAN DATE: TIME:	BOREHOLE O 22 lest
YIELD: TIME: DATE:	
GPM FROM TO YIELD: TIME: DATE:	SCHEDULE 40 PVC BLANK CASING
GPM FROM TO VIELD: TIME: DATE:	0.2 10 7.4 feet
GPM FROM TO THE	SENTONITE-CEMENT
GPM FROM TO	SEAL OR SSACK CEMENT-SAND
TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS	5.5 .0~0.5
OFFURNISHY CLEAR SLIGHTLY CLOUDY AT END OF	BENTONITE PELLET
DEVELOPMENT: MOD. TURBID VERY MUDDY	SEAL _7 :0 5.5.
ODGR OF WATER:	LECUZADO SILICA
WATER GISCHARGED GROUND SURFACE TANK TRUCK TO: GSTORM SEWERS GSTORAGE TANK	SAND PACK
USTORM SEWERS STORAGE TANK ORUMS OTHER	1 INCH DIAMETE
DEPTH TO WATER AFTER DEVELOPMENT: FEET	SLOTTED 1 0.000
MATERIALS USED	7.9 10 18 C 1901
2	2 INCH DIAMETE
3 SACKS OF 20146 COLORADO SILLOS SANO	SCHEDULE 40 PVC BLANK SILT TRAP
CEMENT	18 120 100
4 GALLONS OF GROUT USED. (CENEUT / BENTONITE M	
SACKS OF POWDERED BENTONITE	20 teet
	HOLE CLEANED OUT
10 FEET OF 2 INCH PVC BLANK CASING	SOTTOM OF ROBBHO
ZARO Z MENTANOJ REDLINIKI ORDENED	NOT TO SCALE
YARD ³ CEMENT-SAND (REDI-MIX) USED	ADDITIONAL INFORMATION:
CONCRETE PUMPER USED? MINO DYES	Screen was criginally
NAME	4+ from 9.4-19.5 feet
WELL COVER USED: ELOCKING STEEL COVER	
CHRISTY BOX	well was pulled up 1.5'
	and completed 12/17/91



FIELD WELL COMPLET	TOTAL FORM		_ ,_		CHRISTY SOX
HAME EAKER A	F.B		" [LOCKING STEEL COVE
NUMBER: 3K98	PROJECT MANAGER:	5VG-	- 4	H	STEEL CONDUCTOR
LOGGED LRE	EDITED P	SFN	- i		CASING
MELL EII- TWO	119	DATE: 12/17	191		INCH DIAMETER
COMPANY: AW!	OOL		f''		TO THE
EQUIPMENT: 2 644 INCH	HOLLOW STEM AUGE	MILLEN:	-		SEAL OR
INCH	HOTARY WASH	HOURS)	•		8-SACK CEMENT-SAND
GALLONS OF WATER USED DURING ORILLING:	NONE	GALLONS	-		
METHOD OF DECONTAMINAT: PRIOR TO DRILLING:	on pressure s	ream	•		TOP OF CASING AT
DEVELOPMENT SEE W	er deverop		•		8ELOW GROUND LEVE
METHOD OF DEVELOPMENT:			•		64 INCH DIAMETER
DEVELOPMENT SEGAN PATE:	TIME:		-	}	0 22 .
YIELDI TIMEI	то	DATE:	-		J16 2 INCH DIAMETER
TIME:	то	DATE:	-		BLANK CASING
TIME.	160	DATE	-		0.2 to 5 feet
GPM FROM	× 70	DATE	-		SENTONITE-CEMENT
TOTAL WATER REMOVED		GALLONS	-		8-SACK CEMENT-SAND
OESCRIPTION CLE	AR OS	LIGHTLY CLOUDY	• "		2 ,6 0.5 feer
AT END OF DEVELOPMENT:		VERY MUDDY			BENTONITE PELLET
odor of Water:			-		2 :0 3 'eet
CISCHANGED		K TRUCK	-		SAND PACK
STORM S	SEWERS STOR	RAGE TANK FR			3 10 17 1001
DEPTH TO WATER AFTER DEVELOPMENT:		FEET	•		2 INCH DIAMETER
MATERIALS USED			•		15 to 5 feet
3 carrene Cou	CANDO SILICA	20/45	•		2 INCH DIAMETER
	312(6)		_		BLANK SILT TRAP
	OUT USED (CEMENT				15 to 17 lest
	ERED BENTONITE		ovite ?		BOTTOM WELL CAP
POUNDS OF BENT		SEA	17-18' {	<u></u>	HOLE CLEANED OUT T
4.8 FEET OF 2 IN	ICH PVC BLANK CASII	NG			Zo Im
10-0	THE VEHICLE CO	EEN		L	GOTTOM OF BOREHOLI
			1/4	400	
	CRO (EEDI-MIX) ORD		-	NOT TO SO	ALE -
———— YARD" CEMENT-! CONCRETE PUMPER USED?	SAND (REDI-MIX) USE	D		ADDITION	AL INFORMATION:
Concrete fumper used? Name	NO DYES				
WELL COVER USED: XLOCK	ING STEEL COVER		•		
□chri:	STY BOX				



FIELD WELL COMPLETION FORM	CHRISTY BOX
HAME, EAKER APB BX Shopelle	LOCKING STEEL COVE
HUMBER: 3K98 PROJECT MANAGERI GVCT	STEEL CONDUCTOR CASING
LOGGED JSB EDITED BEN	10
NAME: TWIIZO DATE:	BOREHOLE
COMPANY AW POOL	0 10 30 teer
INCH ROTARY WASH	BENTONITE CEMENT SEAL OR SEACK CEMENT SAND
GALLONS OF WATER DONE GALLONS	SEAL
METHOD OF DECONTAMINATION PRESSURE STEAM	NOTE: STICK DOWN NO.Z
DEVELOPMENT SEE WELL DEVELOPMENT FORM	TOP OF CASING AT ILY,
METHOD OF DEVELOPMENT,	BELOW GROUND LEVE
DEKELOPMENT	BOREHOLE
VIELDI TIMEI	0 in 30 ien
TIELDI TIME: DATE	SCHEDULE 40 PVC
YIELDI TIMEI DATEI	BLANK CASING 2.5 to 17.2 feet
TIELD: THE PATEL	SENTONITE CEMENT
GPM FROM TO	SEAL ON BSACK CEMENTSAND
DURING DEVELOPMENT: GALLONS	SEAL 0.5 .0 /5
AT END OF	BENTONITE PELLET
DEVELOPMENT: MOD. TURBID VERY MUDDY	SEAL 15 :0 16 'est
SDOP OF WATER!	CALORADO SILICA
DISTORM SEWERS DETARGE TANK	SAND PACK 2014C
ODRUMS OTHER	30 10 16 1eet
DEPTH TO WATER AFTER DEVELOPMENT: FEET	SLOTTED 1 0.006
MATERIALS USED	17.2 :0 27.2 (aut
2 100# SACKS OF COLORADE SINCE 20/40 SAND	2 INCH CLAUSTER
COSTIAND THAT	BLANK SILT TRAS
GALLONS OF GROUT USED	27.2 to 24.2 leve
SACKS OF POWDERED BENTONITE	ROTTOM WELL CAP
SO POUNDS OF BENTONITE PELLETS	
20 FEET OF 2 INCH PVC BLANK CASING	HOLE CLEANED OUT TO
REPVENDING SHIPE	
2 PRET OF 2 INCH PUC SUMP.	Joet
YARD CEMENT-SAND (REDI-MIX) ORDERED	NOT TO SCALE
YARDI CEMENT-SAND (REDI-MIX) USED	ADDITIONAL INFORMATION:
CONCRETE PUMPER USED? THO TYES	WELL BAD WAS CONSTRUCTED
NAME	1/9/92 - cut or ~3.0' of
WELL COVER USED: PLOCKING STEEL COVER	RSCK PIPE, COMPLETED WELL
CHRISTY BOX	AS PAISA TO THE

AT 17.154

Halliburton NUS

FIELD WELL COMPLETION	FORM	•		CHRISTY BOX
MANGE CARLA FB	<u> </u>	· ·		D LOCKING STEEL COVER
NAME: PARE A PB	PROJECT A	Jeneral	4-7-7-7	INCH DIAMETER STEEL CONDUCTOR CASING
LOGGED RPH	EDITED HE	elis		10[eet
WELL MW1121		478)95		INCH DIAMETER
COMPANY Ju - State	Nachina	3 -1707.72	.	10feet
EQUIPMENT: /.LTD	LOW STEM AUGER	Tole & Leaner		BENTONITE-CEMENT
	TARY WASH	HOURS VO		B SACK CEMENT SAND
USED DURING DRILLING: N/	1	GALLONS		tofeet
METHOD OF BROOMTAM(HATION PRIOR TO DRILLING:	Steam Clas	7.01		TOP OF CASING AT
DEVELOPMENT SEE WE	u Deverisen			PEET AROVE AT
METHOD OF DEVELOPMENT:				SOREHOLE
DEVELOPMENT SEGAN DATE:	YIME:			0 to 16.7 (see
VIELD: GPM FROM	TO	DATE		2 INCH DIAMETER
GPM PROM	то	DATE		SCHEDULE 40 PVC BLANK CASING
YIELD: TIME:	то	DAYE:		+ 2.4 10 4.2 feet
YIELD: GPM FROM	то	DATE.		SEAL OR
TOTAL WATER REMOVED DURING DEVELOPMENT:		GALLONS		SEAL
DESCRIPTION CLEAR	□ St.	IGHTLY CLOUDY		0 10 10 10 10 10 10 10 10 10 10 10 10 10
AT CHE OF DEVELOPMENT! MOD. TU		ERY MUDDY		BENTONITE PELLET SEAL 1.0 :0 3.0 feet
ODER OF WATER:		——————————————————————————————————————		20/40 MORIE SILL
WATER GROUND SU	RFACE TANK	TRUCK		SAND PACK
TO: STORM SEWE	RS □STORN □ OTHE	GE TANK		3.0 :0/6-7 fact
GEPTH TO WATER AFTER DEVELOPMENT:		FEET		SLOT" ED (D.O.)
MATERIALS USED		014		finch: SCREEN 4. 2 to 14.2 feet
		•		2 INCH DIAMETER
SACKS OFS				ELANK SILT TRAP
SACKS OF		CEMENT		14.2 to 16.2 lest
GALLONS OF GROUT SACKS OF POWDERED			 	BOTTOM WELL CAP
75 POUNDS OF BENTON	_			HOLE CLEANED OUT TO
(4/1) 11 45		G		16.71mm
10.0 FEET OF 2 INCH P	5.5. VCSLOTTED SCRE	ien		BOTTOM OF BOREHOLE
YARDS CEMENT-SAND	· · · · · · · · · · · · · · · · · · ·		NOT TO SCAL	E
YARD CEMENT-SANG				INFORMATION:
CONCRETE PUMPER USED?	NO QYES			
NAME				
WELL COVER USED: LOCKING CHRISTY				
				•



FIELD WELL COMPLET	TION FORM			CHRISTY SOX
name: kala AFB				LOCKING STEEL COVER
IOE	PEDIECT	: A Techno	╶╶┧┠╌┦═╸	STEEL CONDUCTOR CASING
LOGGEO OD II	EDITED -			tofeet
WELL DALKINGS	15	0AT4 17195		BOREHOLE
	Jostin	9///92		tofeet
EQUIPMENT! 16	H HOLLOW STEM A	DEILLET GAAG		BENTONITE CEMENT
_ ·	H ROTARY WASH	HOURS OF		B-SACK CEMENT SAND
ALLONS OF WATER	NA	GALLONS	•••	toJest
METHOD OF OCCURTAMINAT		Seener		TOP OF CASING AT
DEVELOPMENT SE	s were De	Lieuppment Forch		2-3 FEET ABOVE AT
LETHOD OF				10 4 INCH DIAMETER
DEVELOPMENT BEGAN PATE:	7164.	· ····································	j	O 10 17.9
YIELD: GPM FROM	TO	DATE		2 INCH DIAMETER
GPR FROM	70	DATE		SCHEDULE 40 PVC BLANK CASING
GPM PROM	TO TO	DAYE		+ 2.5 to 5.1 feet
GPM FROM	70	SATE:		SEAL OR
OTAL WATER REMOVED	!	CALLONS		8-SACK CEMENT-SAND
DESCRIPTION DEL TURBUTY	5.0	GALLONS SLIGHTLY CLOUDY	6322	0 .02.0 feet
AT END OF	DD. TURBIO	D VERY MUDDY		BENTONITE PELLET SEAL
POOR OF		<u></u>		2.0 :0 4.0 less
	ID SURFACE	EANK TRUCK		SAND PACK
ro: STORM		STORAGE TANK		4.0 to 17.9 teet
DRUMS		OTHER		SLOTTED (O . O)
MATERIALS USED		1250		Sich SCREEN
	44			
SACKS OF	,		1 1	2 INCH DIAMETER
		CEMENT		15.1 10[7.3 leet
GALLONS OF G			<u> </u>	BOT OM WELL CAP
35 POUNDS OF BEN	DERED BENTONIT			HOLE CLEANED OUT T
1.3 PEET OF 1	NTONITE PELLETS	SARING		7.9 Int
10.0 FEET OF 2	9.5.	SCREEN		SOT JOM OF BOREHOL
2.2 Feet of 1	ind 55. 514	r trop		17. 4 toot
YARD ³ CEMENT			NOT TO	SCALE
YARO ³ CEMENT	-SAND (REDI-MIX)	USED	ADDITI	ONAL INFORMATION:
Concrete Pumper USE07	DNO DYES	•		
NAME				
WELL COVER USED: DLOC	KING STEEL COVE	ia		



FIELD WEI	LL COMPLETION	FORM	•					
300				272	_			CHRISTY BOX
NAME:	aker AFE			_	П			LOCKING STEEL COV
NUMBER	0114	PROJECT MANAGER: /	Allan Jenk	ins	41	7	7	STEEL CONDUCTOR
	z. Millar	EDITED EV:	:		Ш	-		CASING to test
WELL NAME:	MW1127		DATE: 11/03/9	_	11		-	- INCH DIAMETER
COMPANY	ri State Te	estina <	services	2_	П		-	BOREHOLE
EQUIPMENT:	LOZHINCH HOL		ORILLES:		Π		-1	SENTONITE CEMENT
	I INCH ROTA	•	HOURS	<u>u f</u> ora				SEAL OR
GALLONS OF W			ORILLED!		1 1	ı	ı	II SEAL -
	CONTANIA		GALLONS EST	ortesikas	7			(0
-		<u>Steam</u>	Cleaning	T LONG SER			7	TOP OF CASING AT
	it see well t	eveloom	ent form	_			1	GELOV GROUND LEVE
DEVELOPMENT		•		_			1	- 10 INCH DIAMETER
TIELDI	TIME	TIME:		_	1	ľ	ſ	BOREHOLE
YIELDI	M FROM T	0	DATE		1	İ		INCH DIAMETER
GPI VIELDI		0	DATE				ı	SCHEDULE 40 PVC BLANK CASING
QPA	TIME: FROM TO)	DATE			1	I	+3 10 34. Feet
GPA	FROM TO)	DATE:				-	SEAL OR
GURING DEVELO	CMOYED PRIENT:		GALLONS	-			-	GSACK CEMENT-SAND
OKSCRIPTION OF TURBIDITY AT END OF	CICLEAR	Oe	IGHTLY CLOUDY	_			Ш	0 ,0 30.5
DEVELOPMENT:	D MOD. TURE		RY MUDDY				1,000	BENTONITE PELLET
ODOR OF WATER:			TAT MODDY	-				కర్కా '' వివాస్తో styr
WATER DISCHARGED	GROUND SURFA	CE TANK	TRICY	•			14	morie 2046 (00N)
YO:	OSTORU SEWERS	□ STORA						SAND PACK
DEPTH TO WATER	ORUMS	DOTHER		1		=	H	2 INCH DIAMETER
AFTER DEVELOP			FEET					SLOTTED (O. O/O
MATERIALS US				. •		Π		inch SCREEN
10 SACK	090899 S of <u>Morie 20</u> 1-	SGACONWE	ill midia				4	- 2 INCH DIAMETER
SACK	S OF				1 1			SLANK SILT TOAR
GALL	ONS OF GROUT USE)	CEMENT					34.5 1036.6
- SACK	S OF POWDERED BE	NTONITE			٩		*†	BOTTOM WELL CAP
-75 POUN	IOS OF BENTONITE P	ELLETS 1/2	buckets					36.5 lest
- SU FEET	OF BLINCH PUC	HANK CARING	5 6 6	>LE				HOLE CLEANED OUT TO
FEET	OF _ A INCH BLE E	OTTEN COREC		. · · · · · · · · · · · · · · · · · · ·			_Ļ	BOTTOM OF BOREHOLE
F-1-4	of 2 inch	5.5.511+	trap					36.5 foet
YARO	³ Cement-Sand (RE)	PI-MIX) ORDER	ŧD.		1 0 T	TO SC	ALE	
CONCRETE -	CEMENT-SAND (RE				VD01	TION	AL I	NFORMATION:
Concrete Pumpei Name	NO (G32U R	Aces						d Sand = 10.92 Secks
-	: OLOCKING STEE							d 9004 - 80.36gals
	CHRISTY BOX							
	MOTHER FIL	Shmour	<u></u>	_				
	·							
								



FIELD WELL	. COMPLETION	FORM		-			CHRISTY BOX
JOB NAME: EQ	N CO					_	D LOCKING STEEL COVE
102	ber AFB	PROJECT		41	-	7_	INCH DIAMETER
100000	Millar	EDITEO	Hlan Jenkins		1	1	CASING
WFL L	W1128	1000	DATE:				INCH DIAMETER
DAILLING		. [.	11105195		į		BOREHOLE
		sking Se	rvices				
	1NCH ROT		MOURS DRILLED				BENTONITE-CEMENT SEAL OR BSACK CEMENT-SAND SEAL
GALLONS OF WAT	TER HILLING:	70	GALLONS	• •	•	•	to (set
METHOD OF DEC	ONTAMINATION <	team C	140 10 100		_	7-	
DEVELOPMENT			Plopment Form	1		11	TOP OF CASING AT
METHOD OF DEVELOPMENT:	•		CIDISTICIO TO TO	İ			BELOW CROOMS TEVE
DEVELOPMENT BEGAN DATE:) .		INCH DIAMETER
VIELDI GPM	TIME:	TIME:	DATE:				0 :0 25 leet 1
VIELD: GPM	TIME	<u> </u>	DATE:				SCHEDULE 40 PVC
VIELD:	71ME:	ro	QAYC:		1		BLANK CASING D to 28 feet
GPM VIELD:	TIME	<u> </u>	DATE			1-1	GENTONITE CEMENT
TOTAL WATER RE	MOMEN	0				┩	SEAL OR SEACK CEMENT SAND
DESCRIPTION	MENT:	···	GALLONS		i		SEAL 23.5
OF TURBIDITY AT END OF DEVELOPMENT:	CLEAR		IGHTLY ÇLOUDY				GENTONITE PELLET
ODOR OF							25.5 <u>. 25</u> 5.
WATER DISCHARGED	GROUND SURF	ACE TANK	TRUCK			+	·[name]
TO:	DSTORM SEWERS	SOSTORA	GE TANK				SANDPACK 40 2515 10 28 1001
DEPTH TO WATER AFTER DEVELOPME		OTHER				-	- A INCH DIAMETER
MATERIALS USE			FEET				SLOTTED (OIO)
	4444	GOONWE	-		=	-	28 to 38 foot
21/2 SACKS	OF Morieze	140 Ailtrat	on media			←	SCHEDULE 40 AVC 53.
SACKS			CEMENT				BLANK SILT TRAP
	ONS OF GROUT US	_	•				BOTTOM WELL CAP
SACKS	OF POWDERED BI	INTONITE	,				40 teet
30	S OF BENTONITE	PELLETS 1/2	bucket	-			HOLE CLEANED OUT TO
10 sector	of <u> </u>	BLANK CASING	W/SH. Cut off	٤.			<u>40</u> : 101
<u>3</u>	of 2 inch	S. S. Sil	t trap				BOTTCM OF BOREHOLE
	CEMENT-SAND IRI	EDI-MIX) ORDER	ED	NOT	TO SC	ALE	
YARD	CEMENT-SAND (R	EDI-MIXI USED		ADD	ITION	AL II	NFORMATION:
CONCRETE PUMPER	USED? QNO	CYVES					sand = 6.86 sacks
	5 1.60****						ed growt= 137 gak
WELL COVER USED:	CHRISTY BOX		_				ions based on
2º borehole to	ZOTHER FIL	ish mou	<u>^+</u>	13:	nch	ko	rhalewisinch
7/4" hove hole to	- 100'	· · · · · · · · · · · · · · · · · · ·		wi	2 in	क	casin -

;12-28-95 ; 4:55PM ;

FIELD WELL COMPLETION	FORM	•					CHRISTY BOX
HAME Eabor AFB				m			LOCKING STEEL COVER
HUMBERI OILL	PROJECT	- 1-1-1-1-1	•	41	-5-	74	STEEL CONDUCTOR
LOGGED G. Millar	EDITED IR	Llan Terkin	02	Ш			GASING
WELL NAME: MW1123	1041 9/-	DATE:	•	Ш			
DRILLING	٠	1811195	•	11	1	14	SOREHOLE
EQUIPMENT:		rvices	. ,				
II INCH ROT	LOW STEM AUGE ARY WASH	MOURE DE LEED	ò√d .	11		1 6	SEAL OR
GALLONS OF WATER	7	Con			1	, ,	SEAL .
METHOD OF DECONTAMINATION PRIOR TO DRILLING:	leam C		vees an		_	9 4	
DEVELOPMENT SEE Well	Develop	leaning	•	ı		1	TOP OF CASING AT
METHOD OF DRY ELOPMENT:	- COCIODI	WAY HOLIVA			1	H	BETOM CHOOMD CENET
DEVELOPMENT BEGANDATE:	TIME		•			1 [MOREHOLE
VIELO: TIME:	TO	DATE		1			Q 70 19:51 1011
VIELD: TIME:	TO	DATE:			1	17	SCHEDULE 40 PVC
AICTO! AIME!		DATE			l		D to 19-Ging
TIELD: TIME	ro	DATE				-	ESENTONITE-COMENT
TOTAL WATER REMOVED OURING DEVELOPMENT	<u>'6</u>			-		+	SEAL OR SEACK CEMENTSAND
DESCRIPTION		GALLONS					SEAL O 10 SIO (see
OF TURBIDITY AT END OF DEVELOPMENT:	\	GHTLY CLOUDY				256 259	BENTONITE PELLET
GDOR OF	PIN □ VE	RY MUDDY					SEAL 310 150
WATER	ACE DEANK T					+	Morie 20140
TO: DSTORM SEWER					\equiv		SAND PACK 5.0 to 19.5 feet
DORUMS DEPTH TO WATER	DOTHER					4	- 2 INCH DIAMETER
AFTER DEVELOPMENT:	1	FEET		1	\equiv		SLOTTED (O/O_)
MATERIALS USED	GA COU	Are.					7.10 to [7.60 feet
SACKS OF Morie an	2140 Filtratio	on medigano			\neg	•	INCH GLAMETER
SACKS OF		CEMENT				-	SCHEDULE 40 PVC S.STEEL
✓ 10 GALLONS OF GROUT US	ED				Į		17.50 10 10 1 cor
SACKS OF POWDERED BE	ENTOMITE \$			"	······································	1	1918 leer . 5 ft of sand
5 125 POUNDS OF BENTONITE		12 budgets	2	-			HOLE CLEANED OUT TO
FEET OF D INCH PVO	ELANK CASING						19.5 141
TO FEET OF TINCH AS	SLOTTED SCREEN	Б ,			-		SOTTOM OF SOREHOLE
YARD ³ CEMENT-SAND (R	EOLMIXI ORDERI	•		MOT	TO SC	A) F	
YAROJ CEMENT-SAND (R	EDIMIX) USED	••					
CONCRETE PUMPER USED? ZINO	□YES						FORMATION:
NAME Grow mixed in	55 gal	drum					
WELL COVER USED: TOLOCKING STE	EL COVER				الجايند	410	d grout = 11.76 gas
OTHER						-	
							



FIELD WELL COMPLETION FORM	CHRISTY BOX
NAME: FOREY AFB	O LOCKING STEEL COV
HUMBER: 0114 PROJECT MANAGER: Allan Tenkins	STEEL CONDUCTOR CASING
WELL G. MICHOUS STI	10feet
DRILLING 9/12/95	BOREHOLE
company. Tri state Testing Services	
INCH HOLLOW STEM AUGER J. C. GLOGO OF COMMENTS OF COMM	BENTONITE-CEMENT SEAL OR BSACK CEMENT-SAN
USED DURING DRILLING,	SEAL
METHOD OF DECONTAMINATION	
DEVELOPMENT Co	TOP OF CASING AT
METHODOP DEVELOPMENT:	SELOW GAOUND LEVI
DEVELOPMENT BEGAN DATE: TIME:	O INCH DIAMETER
TIELDI GPM FROM TO DATE:	<u>0 :0 38 001</u>
YIELD: TIME: PATE:	SCHEDULE 40 PVC
VIELD: TIME: DATE:	BLANK CASING O 10 26 lest
VIELD: TIME! DATE!	SENTONITE-CEMENT
GPM FROM TO	SEAL OR SEACK CEMENT SAND
DURING DEVELOPMENT: GALLONS	SEAL
OF TURBIDITY DELEAR DILIGHTLY CLOUDY	<u>O 10 22 test</u>
MOD, TURBID VERY MUDDY	BENTONITE PELLET
WATER:	22 to 24 · eet
TO: DISCHARGED GROUND SURFACE TANK TRUCK	SAND PACK
DRUMS DOTHER	24:038 feet
AFTER DEVELOPMENT.	INCH DIAMETER
MATERIALS USED	SLOTTED (O · O O
12 1/2 OF 24 95 CASONWELL .	26 en 36 feet
SACKS OF Morie 20/4 Fittration maturano	2 INCH DIAMETER
SACKS OF	I BLANK SILT TRAP
N 65 GALLONS OF GROUT USED	36 10 58 1001
SACKS OF POWDERED BENTONITE	BOTTOM WELL CAP
50 POUNDS OF BENTONITE PELLETS 1 Duckerts	HOLE CLEANED OUT TO
30 FEET OF 2 INCH PVC BLANK CASING 2 Feet 65 CL.	38 1001
of FT of 2 inch so silt trap	BOTTOM OF BOREHOLE
YARD CEMENT-SAND (REDI-MIX) ORDERED	NOT TO SCALE
YARD CEMENT-SAND (REDI-MIX) USED	ADDITIONAL INFORMATION:
CONCRETE PUMPER USED? MINO TYPES	calculated Sand 10.93 sacks
NAME OF TOUT MIXED IN 55 gal drum. NELL COVER USED: MILOCKING STEEL COVER	calculated growt 86.24 gal.
CICHRISTY BOX OTHER	
- v. r.g.,	



FIELD WELL COMPLETION	FORM	CHRISTY BOX
HAME: ENLAY DEB		LOCKING STEEL COVE
100	PROJECT	INCH DIAMETER
OGGED 0114	MANAGER: Allan Jent	CASING
G. Millar	EDITEOUR Ellis	tofeet
IAME: MW1125	10/3/19	SOREHOLE
COMPANY: Tri Stall Tes	stina Services	tafeet
SUIPMENT: 5714 INCH HOL	LOW STEM AUGER J. Crau	BENTONITE-CEMENT
INCH ROTA	1101100	SEAL OR SEAL OR SEAL OR SEAL
ALLONS OF WATER SED DURING DRILLING	~ _	
ETHOD OF DECONTAMINATION	+O GALLONS	
	team Cleaning	TOP DE CASING AT
EVELOPMENT See Well	Development For	BELOW GROUND LEVE
EVELOPMENT: EVELOPMENT	* · · · · · · · · · · · · · · · · · · ·	# JO INCH DIAMETER
EGAN DATE	TIME	0 :0.38 (set
	PATE:	2 INCH DIAMETER
GN FROM	O DATE:	SCHEDULE 40 PVC BLANK CASING
CLD: TIME:	DATE:	+ 2.5 to 26 feet
CLO: TIME	DATE	DENTONITE-CEMENT
TAL WATER REMOVED		- SEAL OR BEACK CEMENT SAND
MING DEVELOPMENT:	GALLONS	— SEAL O 10 20 1001
TURBIDITY DCLEAR	SLIGHTLY CLOUD	
MOD, TURE	D VERY MUDDY	SEAL 22 10 24 1881
VIEN:		Morie 20140(00N)
GROUND SURF		SAND PACK
DRUMS	STORAGE TANK	24 10 38 1001
PTH TO WATER TER DEVELOPMENT:		SLOTTED (0, 010
TERIALS USED	FEET SAK	- inch scaeen s.s.
0 090895	GA CONNELL .	26 to 36 feet
SACKS OF Mone 20	onas elbomnottertuff of	SCHEDULE 40 PME S.S.
SACKS OF		BLANK SILT TRAP
GALLONS OF GROUT US	EO	
SACKS OF POWDERED BE	ENTONITE	BOTTOM WELL CAP
POUNDS OF BENTONITE	reclets 144 bucket	-S
30 FEET OF A INCH PVC	BLANK CASING 1.5ft. C	14 off. 38 1ml
FEET OF INCH SUE	ŚLOTTED SCREEN	80TTOM OF BOREHOUS
a_ Frof Dinch		38 teer
YARD ³ CEMENT-SAND (R)	EDI-MIXI ORDERED	NOT TO SCALE
YARO ³ CEMENT-SANO (RI		ADDITIONAL INFORMATION:
CRETE PUMPER USED? NO	ÒX∕r∈s	Calculated Sand=10.9250
L COVER USED: ALOCKING STE	E. Anus	- calculated grout- 50.360



FIELD WELL COMPLETION FORM	CHRISTY BOX
NAME: FORMENED	D LOCKING STEEL COV
10s	INCH DIAMETE
LOGGEO G. Millar EDITED	STEEL CONDUCTOR CASING
MAME: MULIZA	
ORILLING 1101 195	BOREHOUE
COMPANY: Tri-State Testing Services	
B 714 INCH HOLLOW STEM AUGER T. Crawford	- O BENTONITE CEMENT
INCH ROTARY WASH	SEAL OR SACK CEMENTSANO
USED DURING DRILLING: 52 GALLONS TO EQUAL	THE THE SEAL .
ATTROD OF DECONTAMINATION	
Steam Cleaning	TOP OF CASING AT
DEVELOPMENT See Well Development Form	2.5 5557 (2005
DEVELOPMENT:	I I BECOM CHOOMD LEVE
DEVELOPMENT BEGAN DATE: TIME:	OREHOLE
TIME: DATE	0 :0 41 test
TELDI TIMEI	INCH DIAMETER
TELO: TIME:	SCHEDULE 40 PVC BLANK CASING
GPM FROM TO	+2.510.29 feet
GPM FROM TO PATE:	BENTONITE-CEMENT
OTAL WATER REMOVED.	SEAL OR GSACK CEMENT-SAND
CALLONS	SEAL
T END OF DELEMENT DELIGHTLY CLOUDY	0 .0 22 (00)
DMOD. TURBIO D VERY MUDDY	BENTONITE PELLET SEAL
ATER:	22, 24,
SCHARGED DGROUND SURPACE TANK TRUCK	Morie Dollo (con)
USTORM SEWERS DETORAGE TANK	SANDPACK 2+10-41 (see
TH TO WATER	
TER DEVELOPMENT:	SLOTTED (O. O / O)
TERIALS USED	irch · SCR EEN
1/2 0908956ACONWELL .	29 to 39 feet
1/2 SACKS OF MONE 20HO A: Hration media	SCHEOULE 40 PME ST
SACKS OFCEMENT	I I GLANK SILT TRAP COL
GALLONS OF GROUT USED	37 to 31 feet
SACKS OF POWDERED BENTONITE	BOTTOM WELL CAP
35 POUNDS OF BENTONITE PELLETS buchat	41 leet
THE FEET OF TO ASSESS THE TAX ASSESS	HOLE CLEANED OUT TO
TECTUP OF INCUSIA A AND	
	BOTTOM OF BOREHOLE
- Cinch sisisitrap	<u>~ 1 1000 1</u>
YARDI CEMENTSAND IRECLAUSI CROSSOC	4/ lest
YARD CEMENT SAND (REDIMIX) ORDERED	NOT TO SCALE
YARD CEMENT SAND (REDIMIX) ORDERED	NOT TO SCALE
YARD CEMENT SAND (REDI-MIX) ORDERED YARD CEMENT-SAND (REDI-MIX) USED ICRETE PUMPER USED! QNO MYES	NOT TO SCALE
YARD CEMENT SAND IREDIMIXI ORDERED YARD CEMENT-SAND IREDIMIXI USED ICRETE PUMPER USED! OND XYES	ADDITIONAL INFORMATION:
YARD CEMENT SAND IREDIMIXI ORDERED YARD CEMENT-SAND IREDIMIXI USED ICRETE PUMPER USED! QNO XYES	NOT TO SCALE

SURVDATA.XLS

SAMPLE LOCATION/ELEVATION EAKER AIR FORCE BASE, ARKANSAS

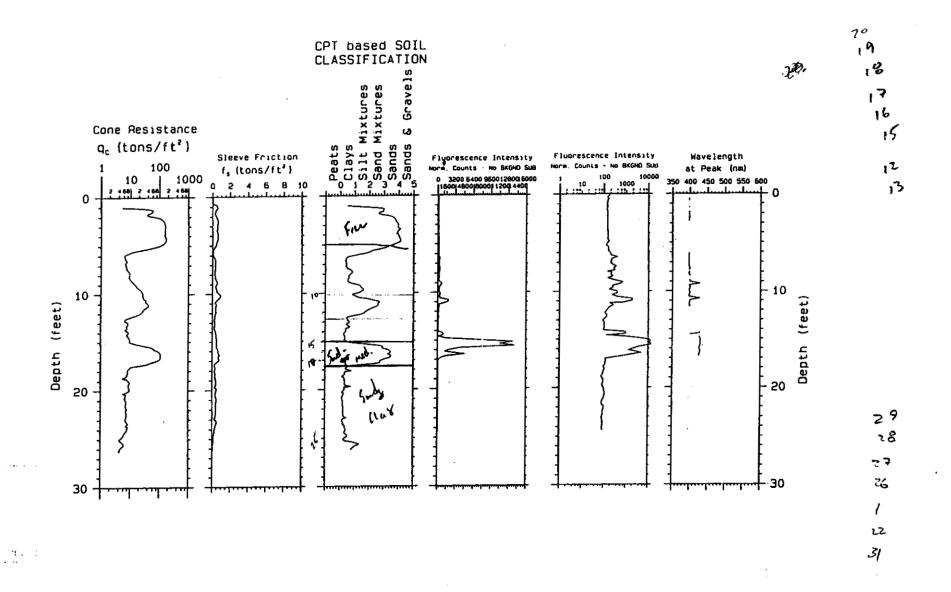
Sample	Elevation	Ground	Coord	Coordinates		
Point	TOC	Elevation	Northing	Easting	Site	
TW1102	249.52		599301,20	2604930,49	BX	
TW1103	249.99		599245.87	2605004.10	18X	
MW1104	251.48		599320.79	2605116.02	BX	
TW1105	251.14		599340.38	2604984.22	BX.	
TW1106	250.98	1	599356.10	2604925.65	EX	
TW1107	251.31		599377.34	2605044.84	BX	
TW1108	250.75		599297.47	2605018.95	BX	
TW1109	250.89		599269.70	2605047.84	BX	
MW1110	251.25		599285.35	2605052.46	BX	
MW1111	251.32		599445.92	2605047.22	BX	
TW1112	250.86	-	599348.57	2605017.22	BX	
TW1113	252.01		599449.00	2604918.04	BX	
MW1114	251.64		599513.89	2604985.04	8X	
MW1115	250.37		599355.32	2604845.78	BX	
MW1116	250.62		599187,31	2604940.79	BX	
TWI117	250.83		599261.14	2605070.50	BX	
TWILLS	250.42		599233.00	2605100.52	DX.	
MW1119	249.75		599198.81	2405113.49	BX	
MW1120	251.73	•	<i>599447,4</i> 1	2604838.18	BX	
MW1121	253.16	250.97	599307.09	2605212.18	BX	
MW1122	253.02	250.68	599428.98	2605029.14	BX	
MW1123	253.56	251.13	599426.94	2604884.90	BX	
MW1124	253.58	251.93	599440.75	2604894.57	EX	
MW1 125	253.48	210.58	599527. 92.	2604778,54	BX	
MW1126	253.70	250.71	599313.88	2605207.14	BX	
MW1127	Z\$0.56	250.76	51181-58	2604946.87	PX	
MW1128	277	- Rema	78 et 3 min	イベベンモウモハ	BX	
CPG	·	251.12	599361.54	2604978.20	BX	
CP19				7-1-1	BX	
C122					BX	
CP26		251.12	599356.27	2604925.70	BX	
Bı		252,18	599386.58	2605029.03	BX	
B2		251.96	599388.57	2605019.62	BX	
B3		251.85	599388.65	2605000.02	TXX	
B4		<u>251.75</u>	599381.05	2604999.58	BX	
B5		251.64	599373.17	2604995.29	BX	
<u>B6</u>		251.77	599350.54	2604998.47	BX	
87		250.97	599348.42	2605017.32	BX	
88		250.98	599340.55	2605031.63	BX	
B9		251.12	599347.35	2605041.38	DX.	
B10		251,23	599354.04	2505048,24	BX	
B11		251.26	599361.16	2605055,91	<u>BX</u>	
B12		251.56	599376.42	2605049,23	BX	
B13	1	252.50	599393.30	2605039.89	BX	

APPENDIX B - 1C

CPT/LIF OUTPUT

BX SHOPPETTE

Source: USACE 1995.



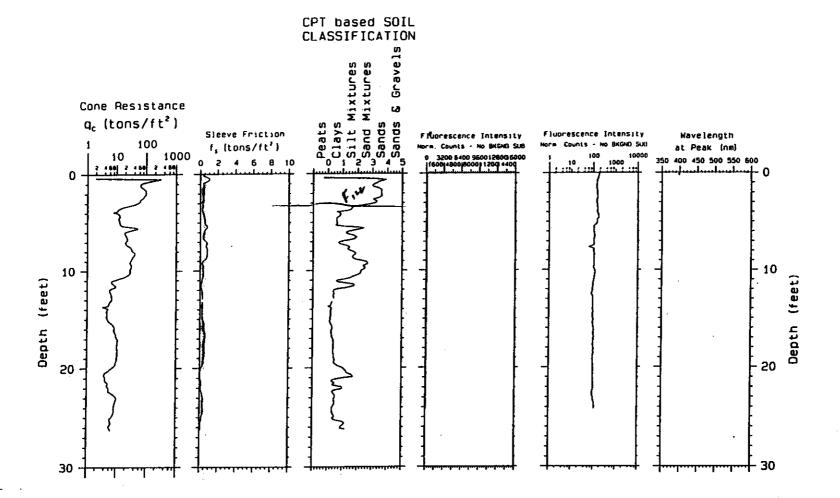
Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Project; Eaker AFB <NEW>
Probe Depth; 26.50

Characterization cPT; 01EAK01

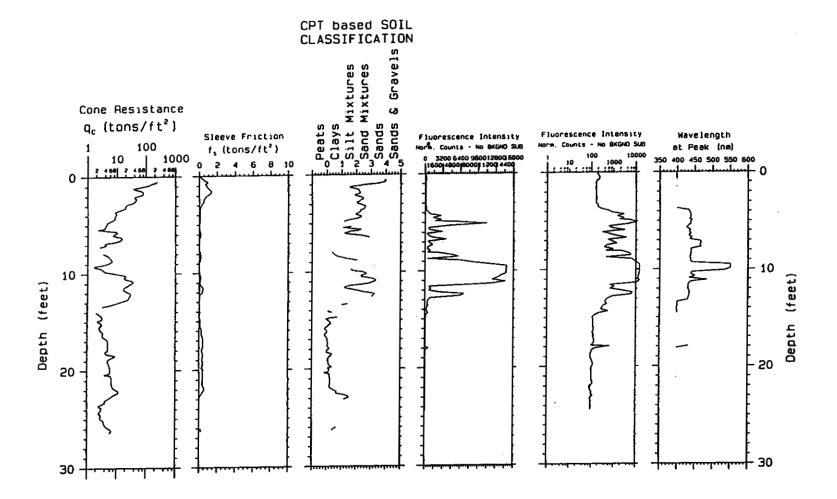


Laser induced fluorescence of POL via fiber optics U.S.Army Engineer District Kansas City Grotechnical Branch



Project; Eaker AFB Probe Depth; 26.45

Characterization and Analysis Penetrometer System CPT; 2EAKO1



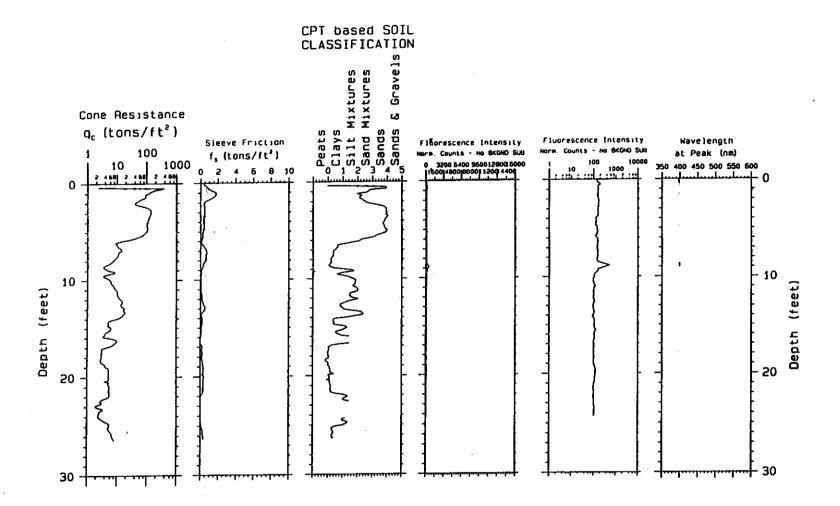
Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Project; Eaker AFB Probe Depth; 26.54

Characterization cpt; 3EAKO1

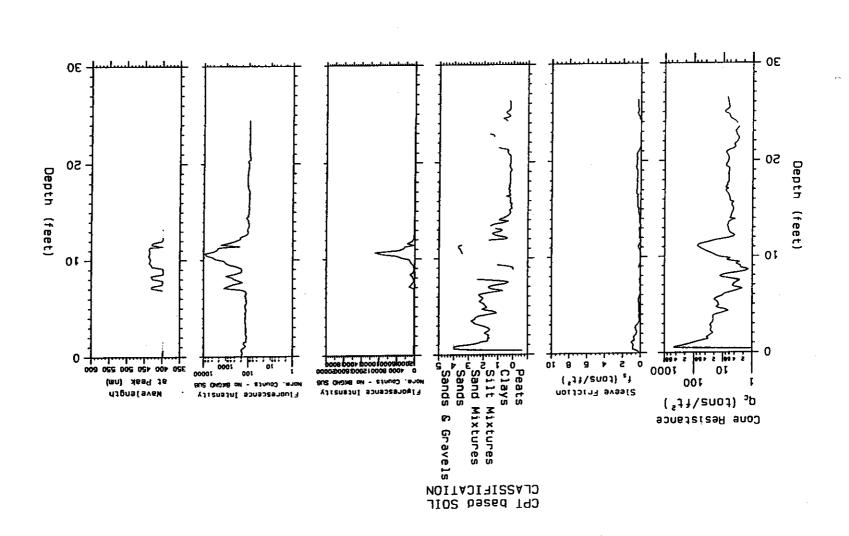


Laser induced fluorescence of POL via fiber optics U.S.Army Engineer District Kansas City Gentechnical Branch



Project; Eaker AFB 26.59 Probe Depth;

Characterization and Analysis Penetrometer System CPT; 4EAKO1



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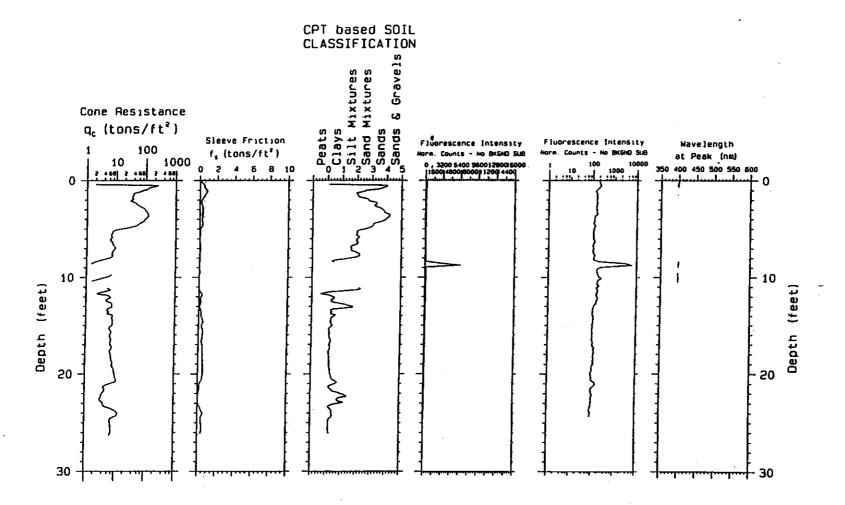
of POL via Leser induced

Project; Eaker AFB

Probe Depth; 18.85

Senetrometer System CPT; SEAKO1

U.S.Army Engineer District Kenses City Kenses City Probing date: 03-24-1995

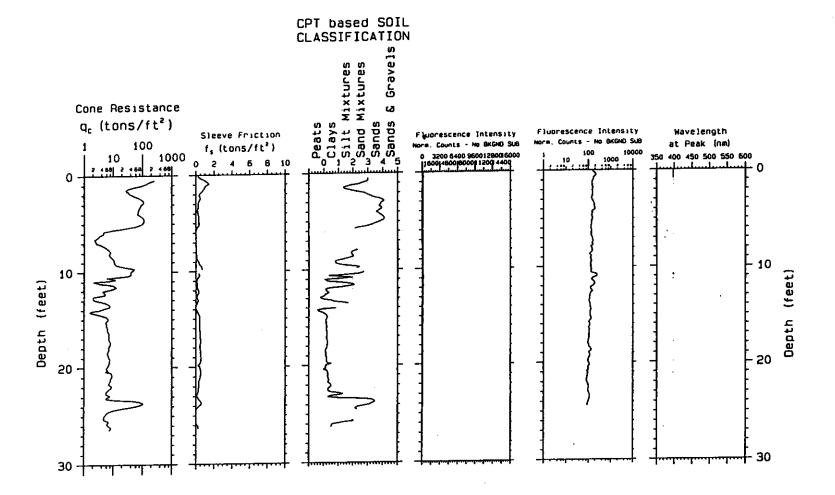


Laser induced
fluorescence
of POL via
fiber optics
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Engineer
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Kansas City
Gentechnical Branch



Project; Eaker AFB Probe Depth; 26.50

Characterization and Analysis Penetrometer System CPT; 6EAKO1

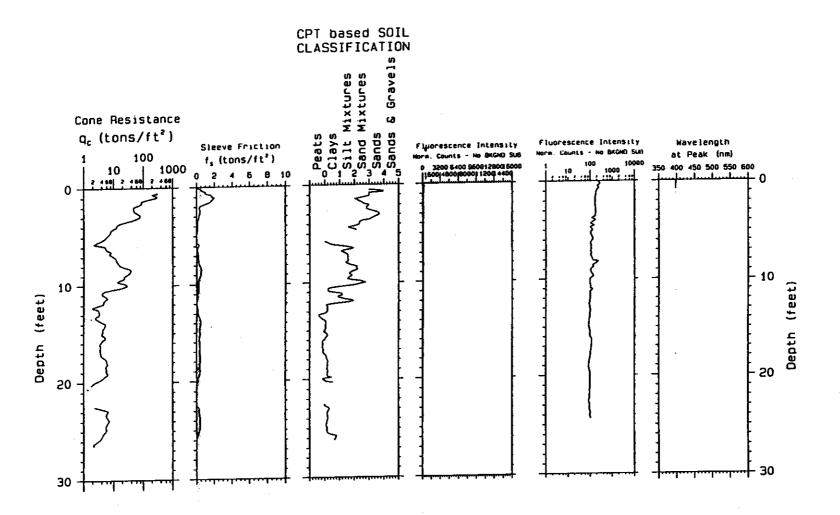


Laser induced
fluorescence
of POL via
fiber optics
U.S.Army
Engineer
District
Kansas City
Geotechnical Branch

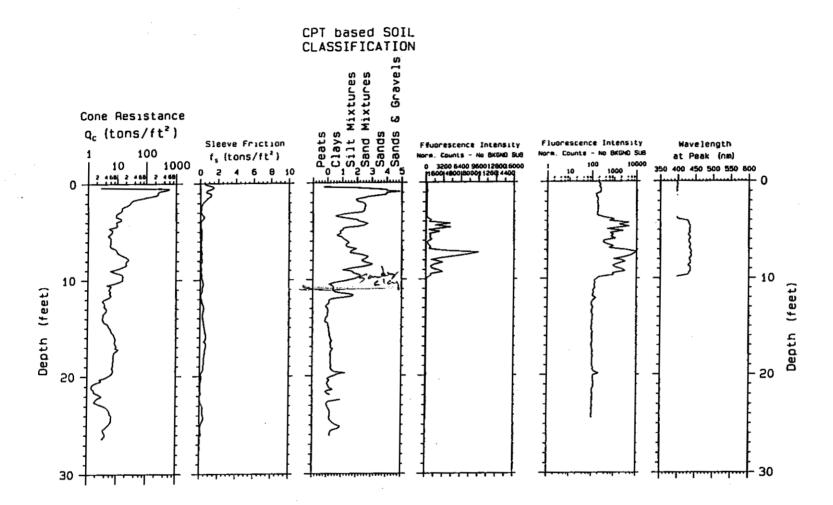


Project; Eaker AFB Probe Depth; 26.55

Site
Characterization
and Analysis
Penetrometer System CPT; 7EAK01





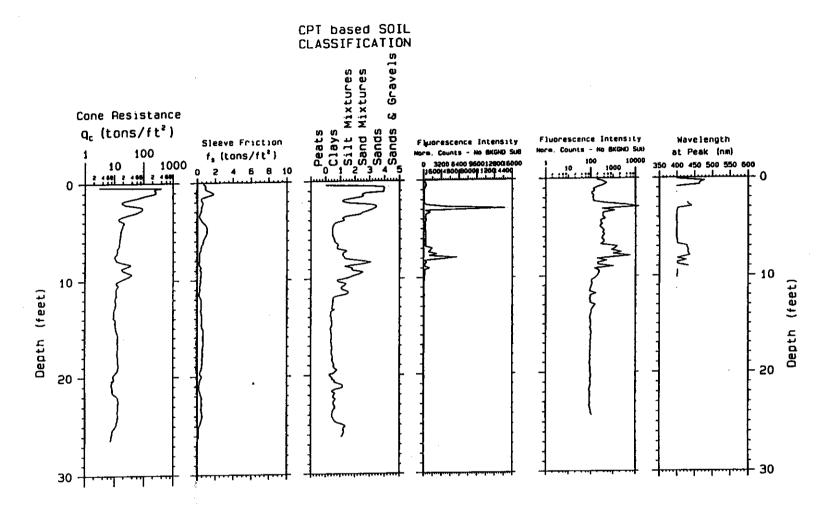


Laser induced fluorescence of POL via fiber optics U.S.Army Engineer District Kansas City Geotechnical Branch Probing date: 03-24-1995

Project; Eaker AFB 26.52

Probe Depth;

Characterization cpt; 9EAK01



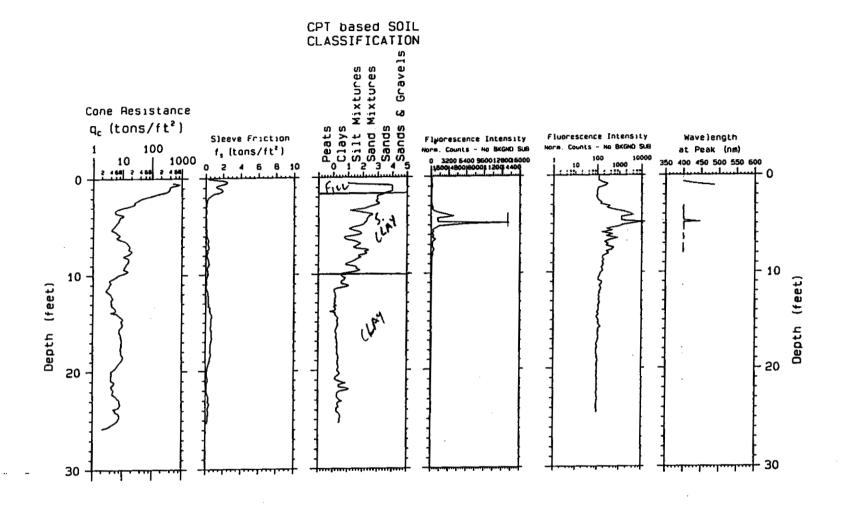
Laser induced
fluorescence
of POL via
fiber optics

U.S.Army
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District
Kansas City
Geotechnical Branch

SCAPS

Project; Eaker AFB Probe Depth; 26.55

Characterization and Analysis
Penetrometer System CPT; 10EAK01



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

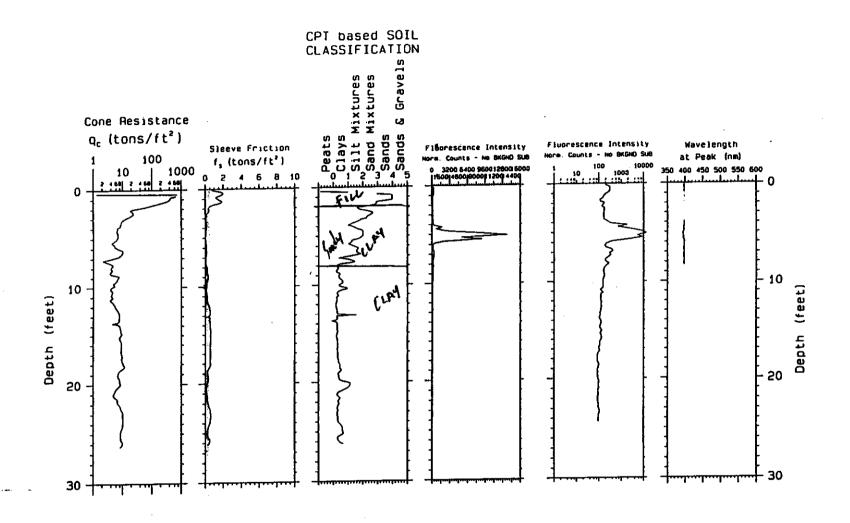


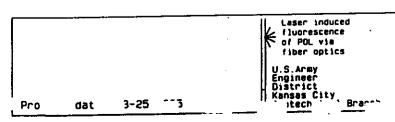
Project; Eaker AFB Probe Depth; 26.62

Site Characterization and Analysis Penetrometer System CPT; 11EAKO1

Probing date: 03-25-1995

14 ...



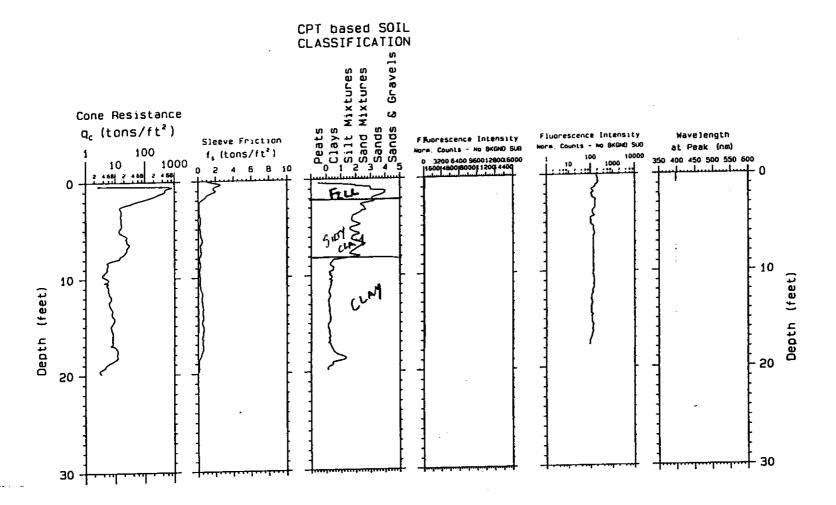


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SCAPS

Project; Eaker AFB Probe Depth; 26.49

Characterization and Analysis Penetrometer System CPT; 12EAK01



Laser induced
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of POL via
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Kansas City
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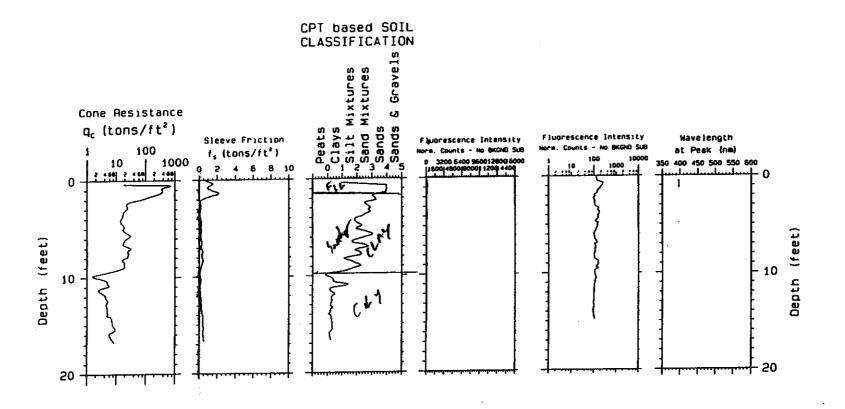
SCAPS

Project; Eaker AFB Probe Depth; 20.05

Characterization end Analysis
Penetrometer System CPT; 13EAK01

Probing date: 03-25-1995

29.5



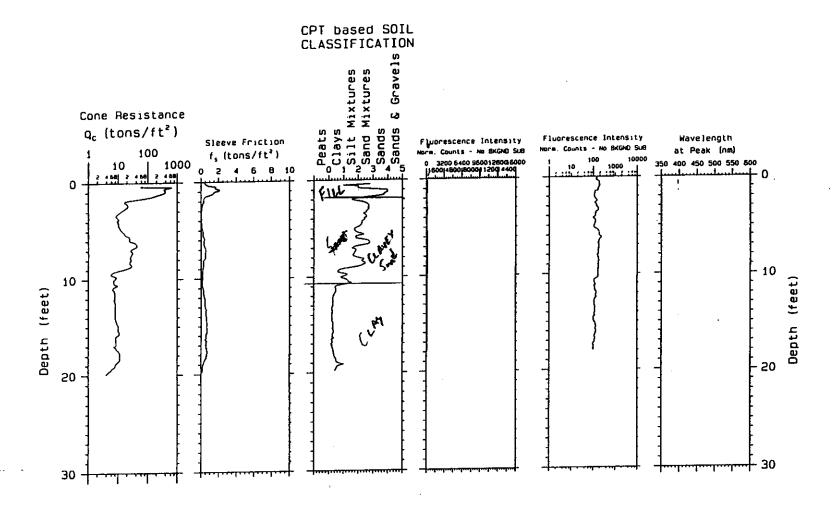
Laser induced
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fiber optics
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Probing date: 03-25-1995

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Project; Eaker AFB Probe Depth; 17.04

Characterization CPT 14FAK01

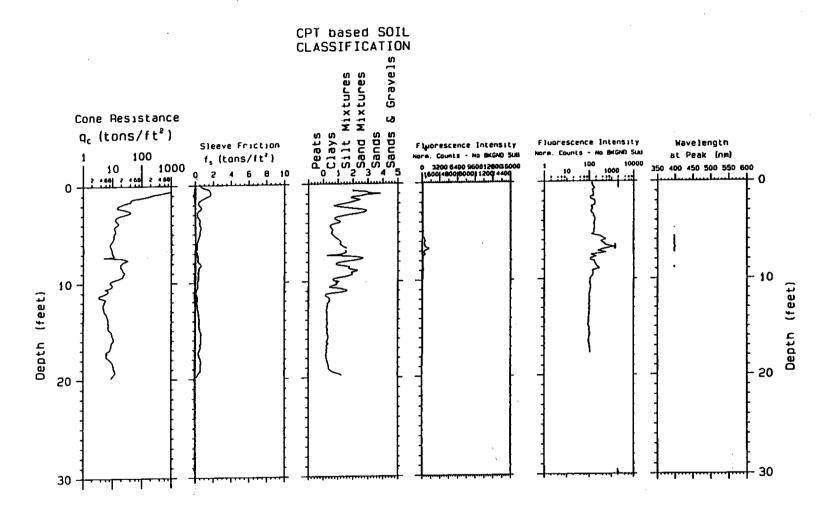


Laser induced
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of POL via
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U.S.Army
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Kansas City
Geotschnical Branch

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Project; Eaker AFB Probe Depth; 20.12

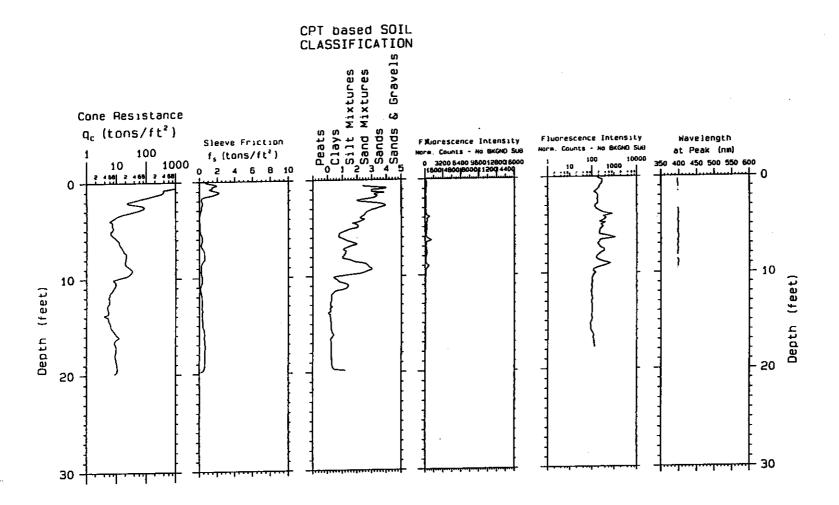
Characterization and Analysis Penetrometer System CPT; 15EAK01



Laser induced
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of POL via
fiber optics
U.S. Army
Engineer
District
Kansas City
Regtechnical Branch

Project; Eaker AFB Probe Depth; 20.05

Characterization and Analysis
Penetrometer System CPT; 16EAK01

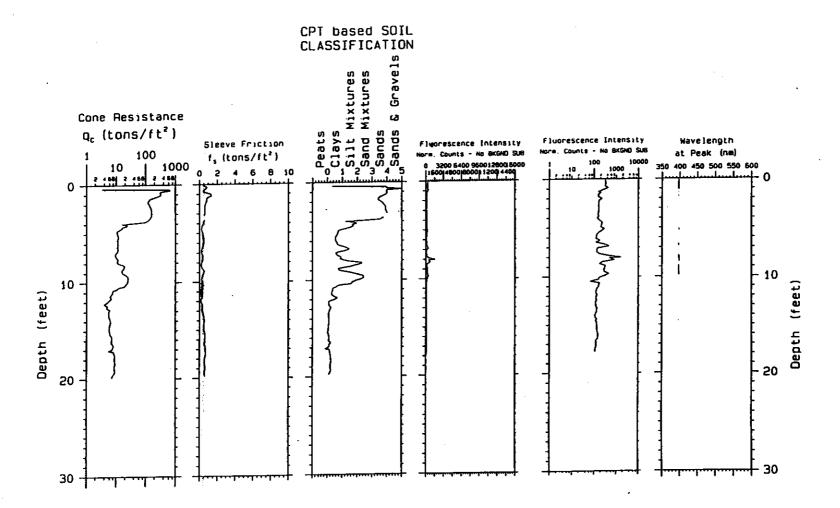


Laser induced
fluorescence
of POL via
fiber optics
U.S.Army
Engineer
District
Kansas City
Geotechnical Branch

SCAPS

Project; Eaker AFB
Probe Depth; 20.03

Site Characterization and Analysis Penetrometer System CPT; 17EAK01

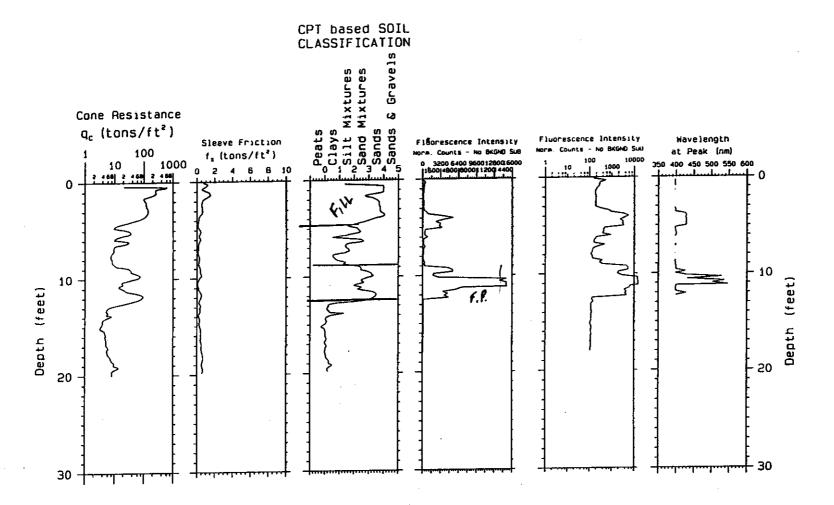


Laser induced
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of POL via
fiber optics
U.S. Army
Engineer
District
Kansas City
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SCAPS

Project; Eaker AFB Probe Depth; 20.09

Site Characterization and Analysis Penetrometer System CPT; 18EAK01



Probing date: 03-25-1995

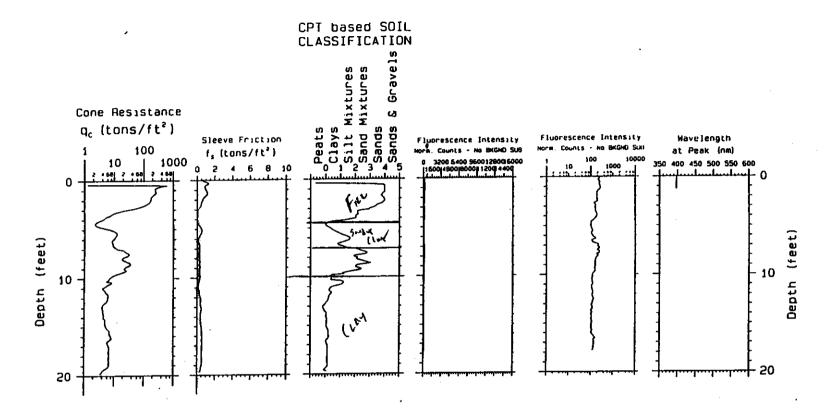
Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch



Project; Eaker AFB
Probe Depth; 20.12

Characterization and Analysis Penetrometer System CPT; 19EAK01



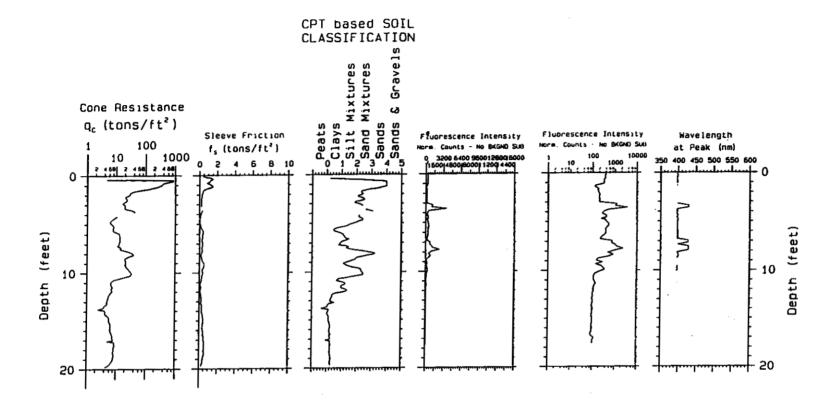
Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Project; Eaker AFB Probe Depth; 19.97

Site Characterization and Analysis Penetrometer System CPT; 20EAK01



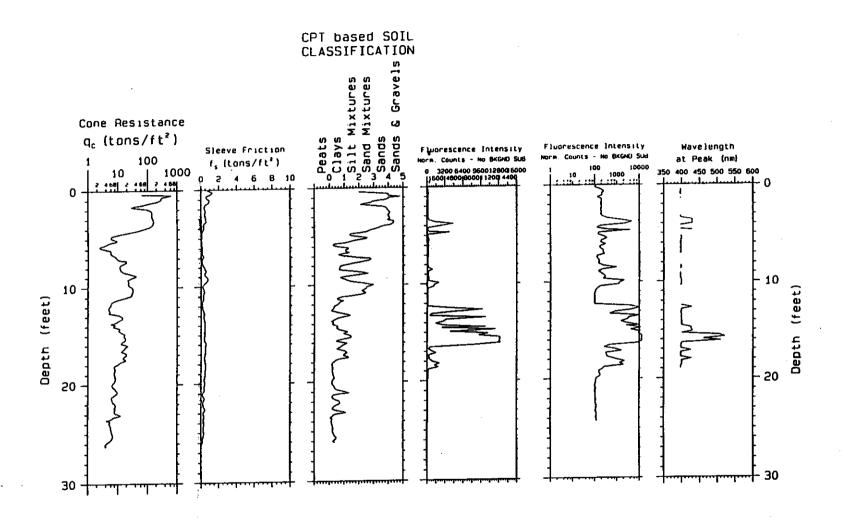
Laser induced
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of POL via
fiber optics

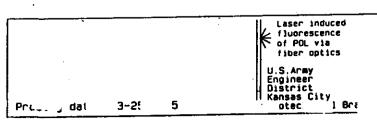
U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Project; Eaker AFB Probe Depth; 19.93

Characterization and Analysis CPT; 21EAKO1

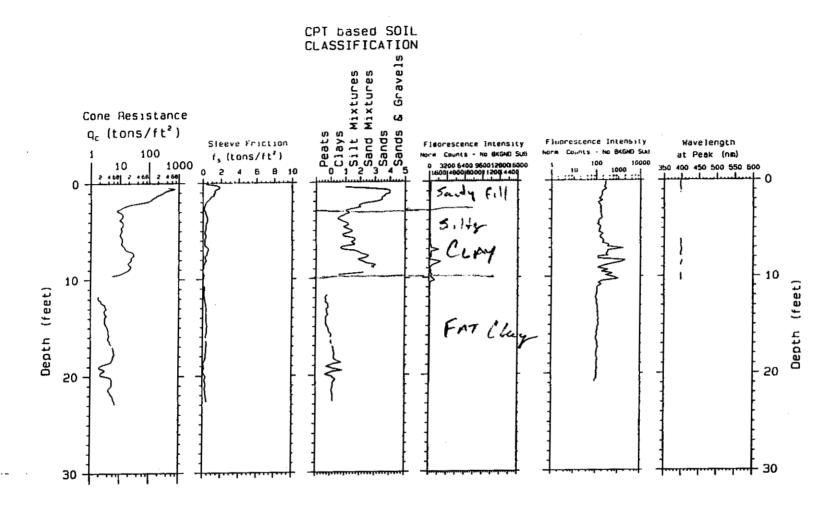




SCAPS

Project; Eaker AFB Probe Depth; 26.46

Characterization and Analysis Penetrometer System CPT; 22EAK01

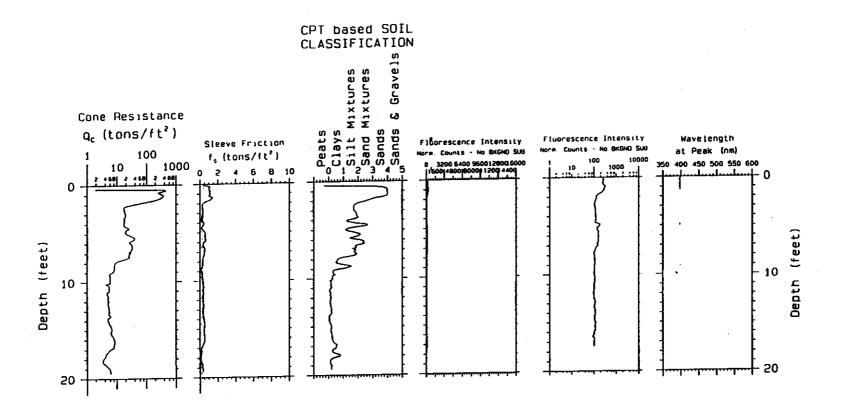


Laser induced
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of POL via
fiber optics
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Engineer
District
Kansas City
Geotechnical Branch

SCAPS

Project; Eaker AFB
Probe Depth; 23.07

Characterization and Analysis Penetrometer System CPT; 23EAKO1



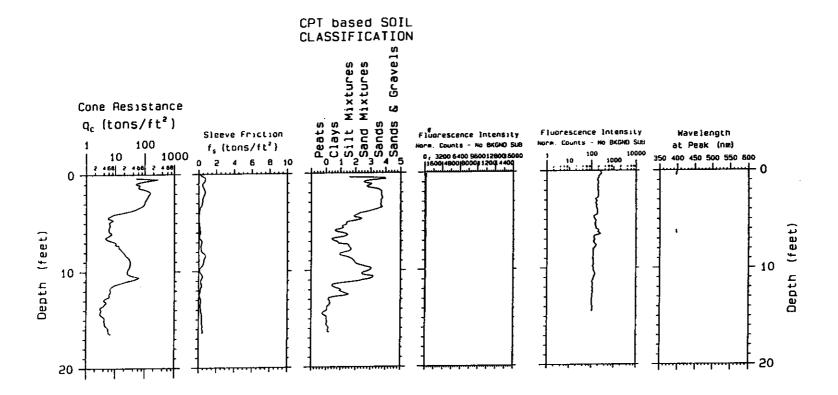
Laser induced
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SCAPS

Project; Eaker AFB Probe Depth; 19.69

Site Characterization and Analysis Penetrometer System CPT; 24EAK01



Laser induced fluorescence of POL via fiber optics U.S.Army

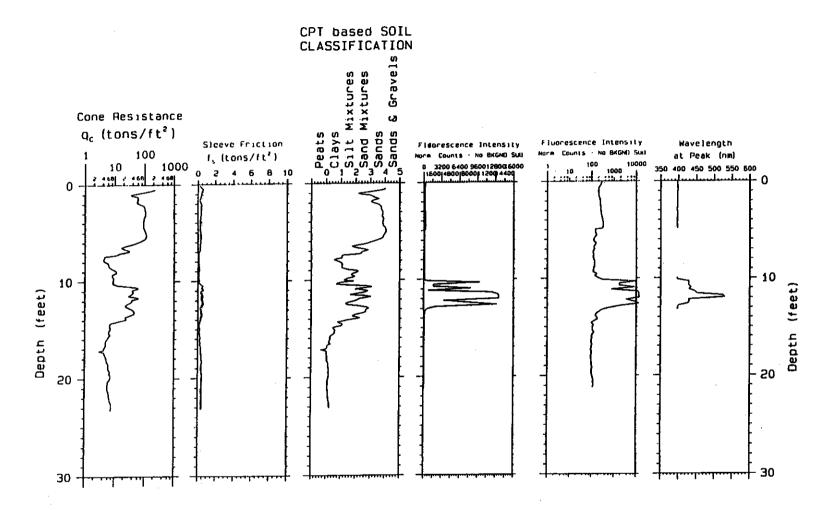
Engineer District Kansas City Geotechnical Branch



Project; Eaker AFB

Probe Depth; 16.65

Site Characterization and Analysis Penetrometer System CPT; 25EAK01



Laser induced
fluorescence
of PDL via
fiber optics
U.S.Army
Engineer
District
Kansas City
Geotechnical Branch

Probing date: 03-25-1995



Project; Eaker AFB Probe Depth; 23.40

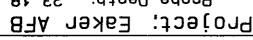
Characterization and Analysis Penetrometer System CPT; 26EAK01

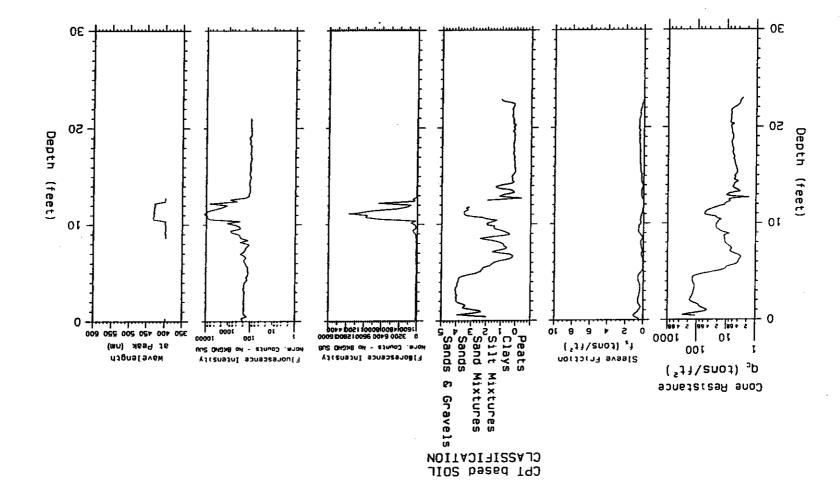
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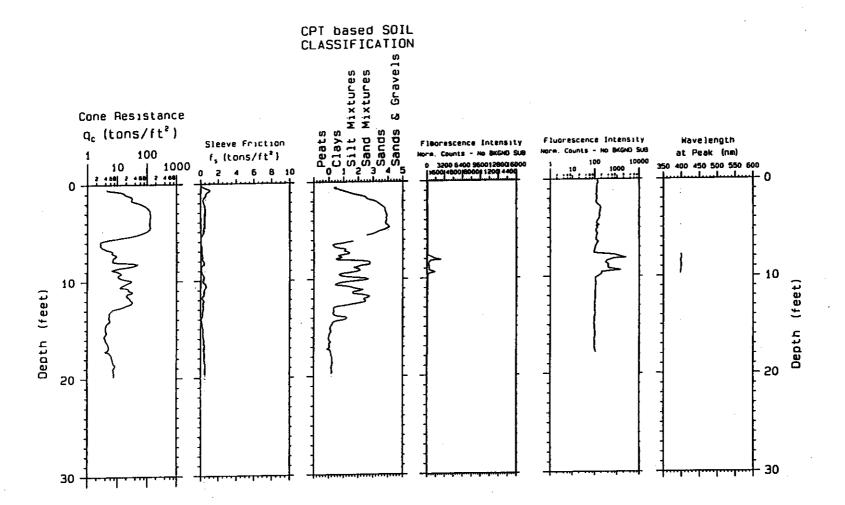
Site Characterisation CPT; SZEAKO1 and Analysis System CPT; SZEAKO1

Probe Depth; 81.65









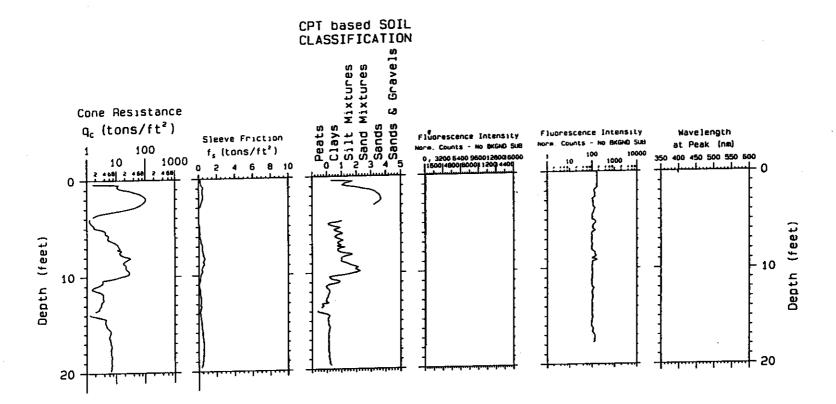
Laser induced
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of POL via
fiber optics
U.S.Army
Engineer
District
Kansas City
Gentechnical Bra

10

SCAPS

Project; Eaker AFB Probe Depth; 20.05

Characterization and Analysis Penetrometer System CPT; 28EAKO1



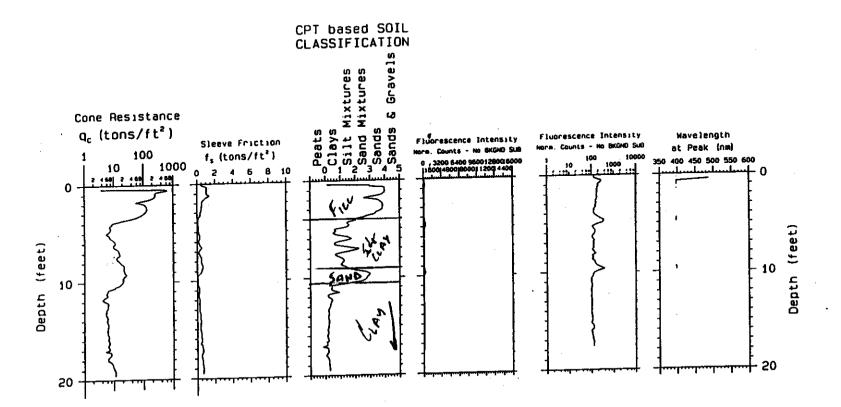
Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch



Project; Eaker AFB
Probe Depth; 19.91

Characterization and Analysis
Penetrometer System CPT; 29EAK01



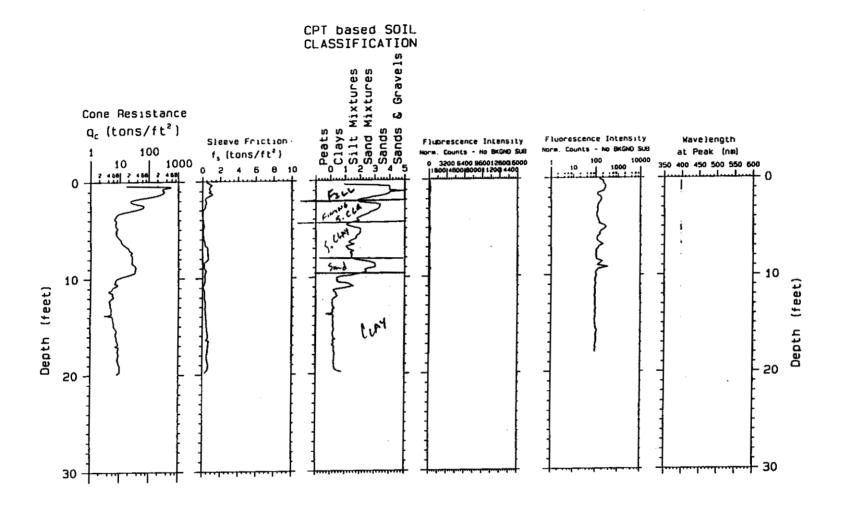
Laser induced
fluorescence
of POL via
fiber optics
U.S.Army
Engineer
District
Laser induced
Fluorescence
Of POL via
Fiber optics
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Probing date, 00-25-...

SCAPS

Project; Eaker AFB Probe Depth: 19.76

Characterization and Analysis Penetrometer System CPT; 30EAK01



Laser induced
fluorescence
of POL via
fiber optics
U.S.Army
Engineer
District
Kansas City
Geotechnical Branch

SCAPS

Project; Eaker AFB Probe Depth; 20.12

Site Characterization and Analysis Penetrometer System CPT; 31EAK01